FASTCAM MH4-10K

Hardware Manual

Revision 1.01E

Photron

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- Photron Limited is not responsible for the aftermath of the results of using the product or from following the instructions in this manual.

Introduction

Thank you for your purchase of Photron's high-speed camera system, the **FASTCAM MH4-10K**.

This manual contains the operating instructions and warnings necessary for using the **FASTCAM MH4-10K**.

Before using the camera, please read the entire manual.

If any part of this manual is unclear, contact Photron using the contact information printed at the back of the manual.

After you finish reading the manual, store it in a safe place along with the warranty card and refer back to it when necessary.

Using the Manual

This section explains the layout of the manual.

Introduction

An explanation of the manual and safety precautions is located here.

Chapter 1. Overview

An overview, and explanation of the features of the **FASTCAM MH4-10K**, are located here.

Chapter 2. Setup

An overview of the components that make up the **FASTCAM MH4-10K**, how to connect the camera head, basic keypad operation, the battery, and a list of items that should be checked before using the camera are also explained here.

Chapter 3. Recording

Operations related to recording are explained here.

Chapter 4. Playback

Operations related to playing back record images are explained here.

Chapter 5. Connecting a PC

The procedure for connecting the **FASTCAM MH4-10K** to a PC is explained here. Refer to the "PHOTRON FASTCAM Viewer User's Manual" for additional details on using the PC to control the camera.

Chapter 6. System Settings

Displayed settings, and other detailed system settings, are explained here.

Chapter 7. Product Specifications

The camera's specifications are found here.

Chapter 8. Warranty

The warranty is explained here.

Chapter 9. Contacting Photron

Contact information to use to contact Photron if the camera malfunctions or a portion of the manual is unclear.

Using the Camera Safely and Correctly

In order to prevent injury to yourself and others, and to prevent damage to property, carefully observe the following safety precautions.

Photron has given its full attention to the safety of this product. However, the extent of damage and injury potentially caused by ignoring the contents of the safety precautions and using the product incorrectly is explained next. Please pay careful attention to the content of the safety precautions when using the product.

Caution	This symbol indicates actions that carry the risk that a person could receive a serious injury.
Warning	This symbol indicates actions that carry the risk that a person could receive a moderate injury, or that damage to physical property will occur.

- The safety precautions to be observed are explained with the following symbols.

This symbol indicates actions that require caution.

This symbol indicates actions that are prohibited and must be avoided.

This symbol indicates actions that must always be performed.

- Do not perform actions that will damage the AC cable or plug.
  (Do not damage the cable, modify it, use it near a heater, excessively bend, twist or pull upon it, place heavy objects on it, or bundle it.)
  Using the cable when damaged can cause fire, electric shock, or a short circuit.

- Do not use the camera in a manner which will exceed the rating of the power outlet or wiring equipment used.
  Exceeding the power rating might cause a fire from excessive heat.

- Do not insert metallic objects into, or pour liquids such as water on, the camera.
  Doing so can cause fire, electric shock, or malfunction from short circuit or heat.

- Do not disassemble or modify the camera.
  There are high voltages inside the camera that can cause electric shock.

- Do not plug in or unplug the power cord with wet hands.
  Doing so can cause electric shock.

- Make sure the power cable is fully inserted into the shocked.
  Not fully plugging in the power cable can cause fire from electric shock or heat.

- When something is wrong with the camera, unplug the power cable immediately.
  - When a foreign substance or liquid, such as metal or water, gets inside.
  - When the outer case is broken or damaged, such as from a fall.
  - When the camera produces smoke, a strange smell, or strange sound.

  Using the camera in these conditions might cause a fire or electric shock.

Caution

- Always unplug the camera when cleaning it or when it is unused for a long period of time.
  Leaving or storing the camera connected to the power source might cause fire from insulation deterioration or electrical discharge.

- Do not set the camera in a location where the temperature might get unusually hot.
  The inside or trunk of a car can get especially hot in summer.
  Doing so can cause the outer case and internal components to deteriorate or cause a fire.

- Do not set the camera in a location prone to oily smoke or steam, or in a location with a lot of humidity or dust.
  Oil, moisture, and dust conduct electricity, which can cause a fire or electric shock.

- Ambient temperature 0-40℃, Humidity 85% RH or lower, Maximum altitude 2000 m or lower. In addition, if exceeding these limits, use in a condensation-free environment.
  Using the camera outside these limits might cause malfunction.

- Do not store the equipment in a location where the temperature goes below -20℃ or higher than 60℃.
  Also keep condensation from forming in the system.

- When shipping, remove the cable connecting the camera controller and the camera head and put the equipment in its original packaging or in a specialized carrying case.
  Do not ship the equipment in an environment where the temperature goes below -20℃ or higher then 60℃ and prevent condensation from forming during shipment.

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Chapter 1. Overview

1.1. Product Overview and Features

1.1. Product Overview and Features

The **FASTCAM MH4-10K** is a camera that, by employing ultra-compact camera heads, makes it possible to shoot in locations not previously accessible to conventional high speed camera heads.

As for the performance of the **FASTCAM MH4-10K**, it can record at a maximum resolution of 512 x 512 pixels at 2,000 fps (frames per second) at this full frame resolution, and up to a maximum speed of 10,000 fps at reduced resolution. It is possible to record simultaneously with a maximum of four camera heads attached to one controller case, even during high-G events, thanks to the high-G design and construction of the camera heads and controller

Using real-time video output and an easy-to-use remote control, the camera can operate fully without a PC connected. By connecting the camera controller to a PC via gigabit Ethernet, full camera operations can be performed on the PC with the easy to use control software supplied.

Utilize the **FASTCAM MH4-10K** to view high-speed dynamic bodies slowed down with the latest technology as an input system for video image processing. This manual explains the operating procedures for the **FASTCAM MH4-10K**.

Chapter 2. Setup

2.1. About the Camera's Components and Accessories

2.2. Part Names

2.3. Device Connections

2.4. Basic Keypad Operation

2.5. Memory Backup Battery

2.1. About the Camera's Components and Accessories

2.1.1. Components

The system's standard components are listed below.

Remove the components from the packaging and check the camera controller and accessories.

1.	Camera Controller	1
2.	Camera head(s)	(depends on configuration)
3.	Camera Cable(s)	(depends on configuration)
4.	AC Adapter/AC Cable	1
5.	Hexagonal Flange Back Adjustment Wrench (1.5 mm)	1
6.	I/O (Input/Output) Cable	1
7.	Gigabit Ether Interface Cable (LAN Cable)	1
8.	FASTCAM series Setup Disk (Driver/Application)	1
9.	FASTCAM MH4-10K Hardware Manual (this manual)	1
10.	PHOTRON FASTCAM Viewer User's Manual	1
11.	Warranty Card	1

2.1.2. Accessories/Options

The following options are available for the **FASTCAM MH4-10K**.

1. High-G Housings (High-G Lens Housing, Screw Reinforcement Housing)
2. Tripod Adapter
3. Fixing Brackets (For the Camera Controller, Normal Camera head, High-G Camera head)
4. High-G Battery
5. High-G Camera Cable
6. Cable Anchor Handle
7. LCD Monitor Keypad
8. NF Mount Lenses (Focal Lengths f=3.5mm, f=6mm, f=12 mm)
9. C mount Adapter

Examples with the optional parts installed are shown below.

High-G Lens Housing Installation Example

Screw Reinforcement Housing Installation Example

High-G Camera head Fixing Bracket Installation Example 1

High-G Camera head Fixing Bracket Installation Example 2

*(The high-g camera head fixing bracket and the normal camera head fixing bracket are the same except for their width)

Tripod Adapter Installation Example

Cable Anchor Handle Installation Example

Camera Controller Fixing Bracket Installation Example 1

Camera Controller Fixing Bracket Installation Example 2

2.2. Part Names

The **FASTCAM MH4-10K** is composed of multiple components which include the camera controller, camera head or heads, AC adapter, and the control software "**PHOTRON FASTCAM VIEWER**" (referred to below as **PFV**).

For each of the FASTCAM MH4-10K components:

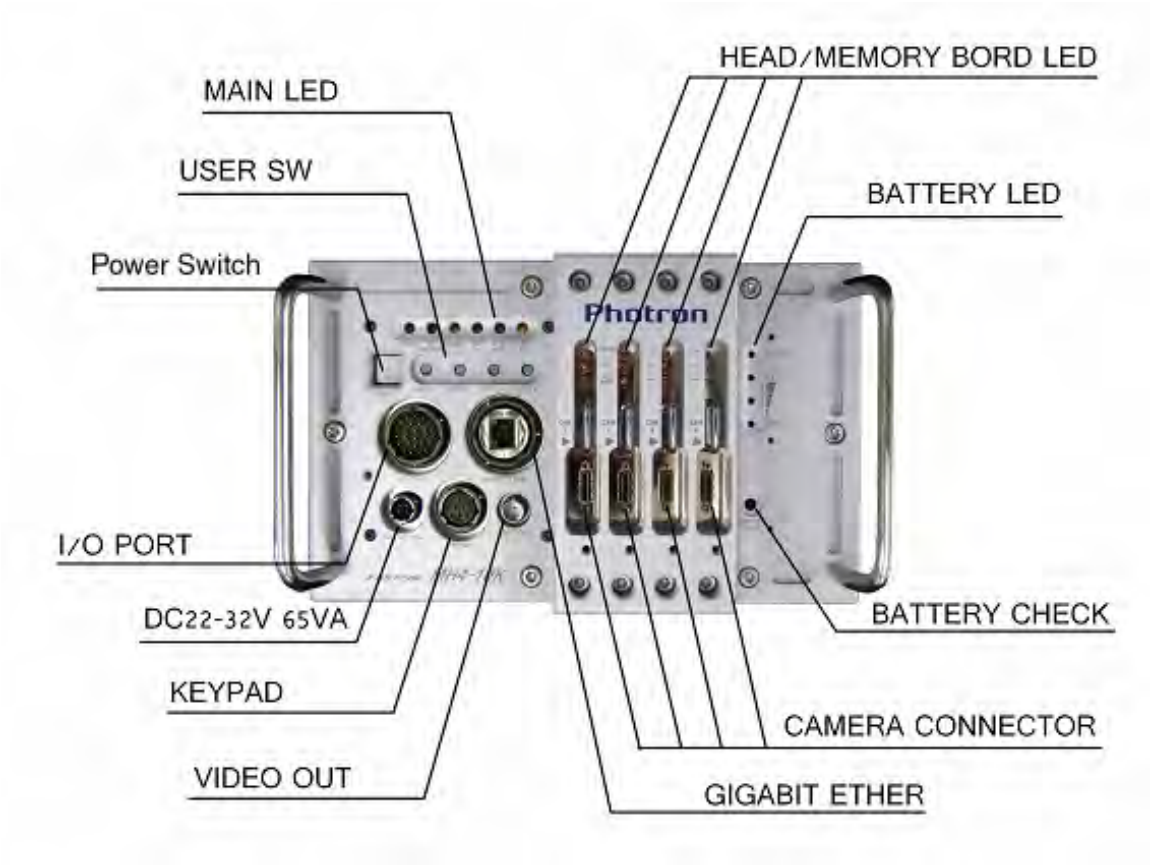
- Do not expose to shock outside of specifications.
- Do not use in an area with flammable gas or dust present.
- Do not place in an unstable location such as on a wobbly platform or an incline.
- Do not disassemble or modify.
- Do not expose to liquids such as water.
- Do not use in a manner with excessive force.

2.2.1. Camera Controller

The FASTCAM MH4-10K has two models depended on memory size. Model 1 with a memory capacity of 1 GB per camera unit, and model 2 with a memory capacity of 2 GB per camera unit. They contain IC memory for saving images, and they have been designed with the capability to save high-speed images as uncompressed digital data. The camera controller has a video output connector to display live and recorded images on a video monitor, a Gigabit Ether interface to connect a PC to fully control the cameras or download data, and various I/O (input/output) connectors for external synchronization/trigger signals.

Camera Controller Exterior

2.2.2. Camera Controller Part Names



Front Panel

2.2.3. LED Explanation

The **FASTCAM MH4-10K** camera controller has a number of LEDs on its front panel. These LEDs indicate the status of the **FASTCAM MH4-10K**. The function of each LED is explained here.

- MAIN LED

- POWER (Green)

  LED ON: Power On
  LED OFF: Power Off

- IF LINK/TRANS (Red)

  LED ON: The Gigabit Ether interface is connected.
  LED FLASHING: Data is transferring.
  LED OFF: The Gigabit Ether interface is not connected.

- TRIGGER (Yellow)

  LED ON: A trigger signal is present (being input).
  (The LED will light for 0.1 second when the trigger signal is input.)
  LED OFF: The trigger signal is not present.

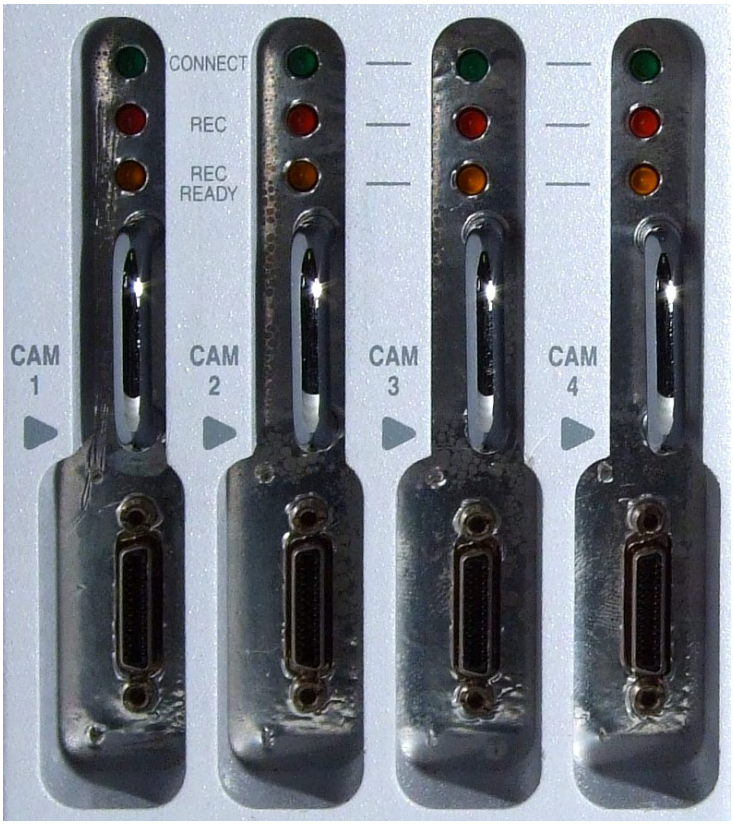
- SYNC MODE (Red)

  LED ON: In external synchronization mode (synchronized to external signal)
  LED OFF: In internal synchronization mode (synchronized to the internal signal)

- SYNC IN (Yellow)

  LED ON: A synchronization signal is Present (being input).
  LED OFF: The synchronization signal is not being present.

- HEAD/MEMORY BOARD LED



- CONNECT (Green)

  LED ON: The camera controller is communicating with the camera head.
  The LED will not light just by connecting the camera cable.
  LED OFF: The camera controller is not communicating with the camera head.

- REC (Red)

  LED FLASHING: Recording.
  LED OFF: Not recording.

- REC READY (Yellow)

  LED ON: Ready to record.
  LED FLASHING: ENDLESS recording. (The REC (Red) LED is also flashing)
  LED OFF: Not ready to record.

■ BATTERY LED

- CHARGE (Red)

  LED ON: The battery is charging.

  LED OFF: The battery is not charging.

- FULL (Green) → (Yellow) → (Red) EMPTY

  Indicates the remaining battery power.

Green	Yellow	Red
Remaining Battery Power 100 - 90%	Remaining Battery Power 89 - 21%	Remaining Battery Power 20 – 0%

The battery's condition is also indicated by the LED status.

LED ON: Running on external power.

LED FLASHING: Battery power memory protection.

2.2.4. Camera head

The **FASTCAM MH4-10K's** camera head has been designed to be smaller than the previous models. The camera head has been reduced to a revolutionary small size, while maintaining high specifications such as a 512 x 512 resolution at recording rates up to 2000 fps.

There are a total of four types of camera heads to select from: two types are color and monochrome, and these types are available with two types of cable attachments, straight and right angle. These four types of camera heads can be used to record in inaccessible space.

Multiple camera heads can also be connected to a single camera controller, and by operating the cameras with a common synchronization signal, a single phenomenon can be simultaneously shot from multiple angles.

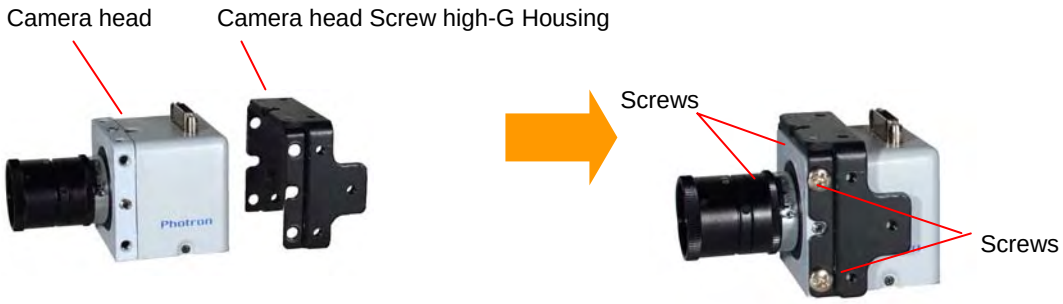
Straight

Right Angle

A high-g housing for the camera head is available as an option. By installing the housing, the high-g capability of the camera can be enhanced. The procedure for installing the high-g housing on the camera head is explained below.

1. Prepare the camera head screw reinforcement housing facing the direction shown in the photo.

2. Attach it to the camera, as shown below, and fasten it with the four screws provided as shown below.



2.2.5. Camera Cable

A cable is required to connect the camera controller and the camera head on the **FASTCAM MH4-10K**. Camera cables come in three configurations, **straight, right angle down and right-angle up**. In addition, the camera cables also come in two additional specification types: **general specification** and **high-g specification**. Many different phenomena can be shot by selecting the appropriate camera head and cable for the situation.

■ Photos of a **general specification cable** attached to a camera head (right-angle camera head shown)

Straight

Right Angle Down

Right Angle Up

■ Photos of **a high-g specification cable** attached to a camera head (high-g housing attached, right-angle camera head shown)

Straight

Right Angle Down

Right Angle Up

When securing the camera cable, do not bend it R50 or lower.

Always secure the camera cable externally in one location within 60 cm of the connector. Failing to do so can cause malfunction.

2.2.6. Lenses

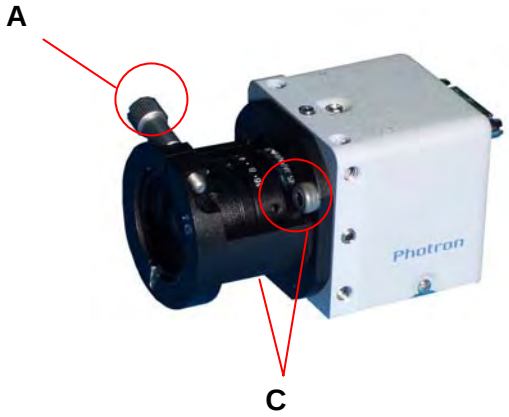
The basic lens mount for the **FASTCAM MH4-10K** is the NF mount, and NF lenses are available as an optional price list them. The NF mount can also be changed to a C mount by using the optional C mount adapter.

Specialized high-g housings (optional) are also available for the optional lenses. The high-g capability of the lens can be enhanced by attaching the high-g housing. The procedure for installing the high-g housing on the lens is explained next.

There is a separate high-g is available for each type of optional lens.
Use the appropriate high-g housing for the lens used.

1. With the lens attached to the camera head, prepare the high-g lens housing facing the direction shown below. Loosen screw A at this time and peel off the stickers used to cover part B.

2. Cover the lens with the high-g housing and lightly tighten screw A so the housing won't move. Then secure section C and its diagonal opposite with hex-screws, and finally, firmly tighten screw A.



2.2.7. LCD Monitor Keypad (Optional)

The **FASTCAM MH4-10K's** LCD monitor keypad (optional, referred to below as the keypad) connects to the **KEYPAD** connector on the camera controller, and the camera can be operated using it. An LCD monitor is attached to the keypad making it possible to use the keypad as a video monitor to set up the camera and check the images. The keypad is also hot-pluggable, so it can be plugged in to the camera controller while the power is on.

Camera-side Connector Name	Signal Name	Connector Model Name Camera-side	Connector Model Name Keypad-side
KEYPAD	Keypad Signal	PT02A-12-10S (023) Amphenol	PT06A-12-10P (023) Amphenol

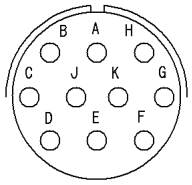
NOTE: The keypad is optional. It is not included in the standard configuration.

2.2.8. About RS-422

The **FASTCAM MH4-10K** is compatible with RS-422 control through the keypad connector.

A cable is not offered as an accessory. When using RS-422 control, construct a cable using the pin diagram below as a reference.

[Keypad Pin Diagram]



PT02A-12-10S (023)

Connector Name	Signal Name	Pin Num	Body-side Connector Model Name (Maker)	Cable-side Connector Model Name (Maker)	Input Connector
KEYPAD	+12V OUT	A	PT02A-12-10S (023) Amphnol	PT06A-12-10P (023) Amphenol	NON
	SIGNAL GND	B			
	RXD+	C			
	RXD-	D			
	TRIGGER SW	E			
	TXD-	F			
	TXD+	G			
	POWER GND	H			
	VBS GND	J			
	VBS	K			

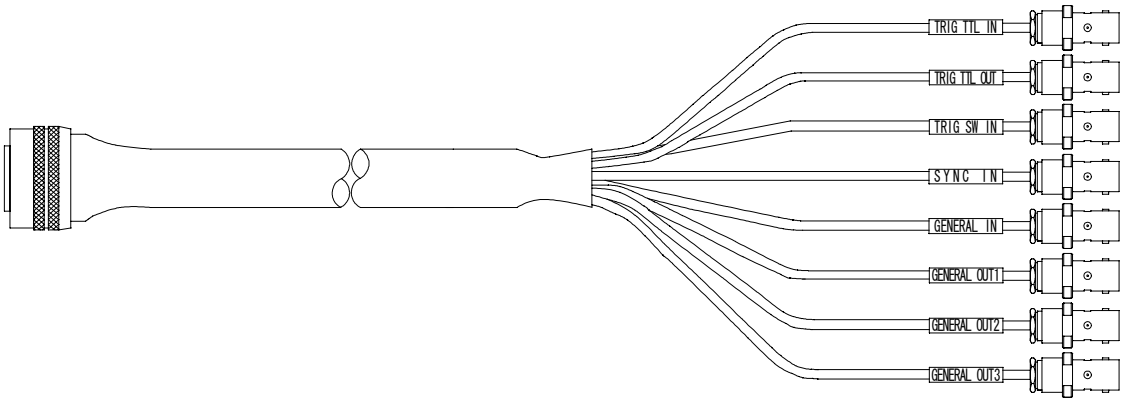
When using the connector pins directly, refer to the chart above and ensure the wiring is correct. Incorrect wiring can cause malfunction.

The voltage on pin A (+12V OUT) is used to power the keypad, do not use it for other purposes.

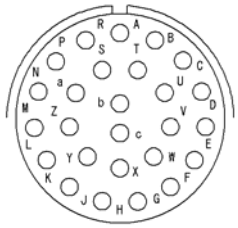
2.2.9. I/O Cable

By inputting an external trigger or synchronization signal and by outputting an exposure timing or synchronization signal, these signals can be used as a part of the **FASTCAM MH4-10K** system. The input/output signal connectors on the **camera controller** have been bundled into a single connector, the **I/O** connector, and it is possible to connect to access each type of signal by using the specialized multi-connector.

A signal other than the specified signal must not be input to the various connectors.
Use extreme caution as there is a risk of damage to both devices, the input device and the output device.
For signals that can be input, refer to “3.10. Input/Output Signal Types”



[I/O Pin Diagram]



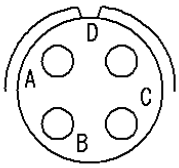
PT02A-16-26P (023)

Connector Name	Signal Name	Pin Num.	Body-side Connector Model Name (Maker)	Cable-side Connector Model Name (Maker)	Input-side Connector
I/O	TRIG TTL IN	A	PT02A-16-26P(023) Amphenol	PT06A-16-26S(424) Amphenol	BNC
	TRIG TTL OUT	B			BNC
	TRIG SW IN	C			BNC
	SYNC IN	D			BNC
	GENERAL IN	E			BNC
	GENERAL OUT1	F			BNC
	GENERAL OUT2	G			BNC
	RESERVE	H			–
	RESERVE	J			–
	RESERVE	K			–
	RESERVE	L			–
	RESERVE	M			–
	RESERVE	N			–
	RESERVE	P			–
	RESERVE	R			–
	POWER GND	S			–
	GENERAL OUT3	T			BNC
	SIGNAL GND	U			BNC SHIELD
	POWER GND	V			–
	POWER GND	X			–
	+22～32V IN	Y			–
	+22～32V IN	Z			–
	+22～32V IN	a			–
	RESERVE	b			–
	RESERVE	c			–

Pin U’s SIGNAL GND signal is the BNC ground.

2.2.10. DC 22 − 32V 65VA Connector

The DC power supply input connector. Connect supplied AC adapter or optional High-G Battery.

[DC22-32V 65VA Pin Diagram]

PT02A-8-4P (023)

Connector Name	Signal Name	Pin Num.	Camera Controller-side Connector Model Name (Maker)	Cable-side Connector Model Name (Maker)
DC22-32V 65VA	RESERVE	A	PT02A-8-4P (023) Amphenol	PT06A-8-4S (424) Amphenol
	SIGNAL GND	B		
	POWER GND	C		
	+22～32V IN	D		

2.3. Device Connections

2.3.1. Connecting the Camera head

Follow the procedure below to connect the **camera head** to the **camera controller.**

1. Verify that the **camera controller's** power is off.

2. Connect the **camera cable.** Check the connector part of the **camera head** and **camera controller** and connect as shown in the pictures below.

■Camera Controller

General Cable

Fix with a screw

High-G Cable

■Camera head

◇For the Straight Camera head

Straight

Right-Angle Down

Right-Angle Up

◇For the Right-Angle Camera head

Straight

Right Angle-Down

Right Angle-Up

◇For the Straight Camera head with High-G Housing

Straight

Right-Angle Down

Right-Angle Up

◇For the Right-Angle Camera head with High-G Housing

Straight

Right-Angle Down

Right-Angle Up

3. Verify that the connector's **screws** are correctly tightened.

Always secure the camera cable by tightening the screws attached to the camera cable's connector.

If the camera cable pulls out while the power is on, it can cause malfunction.

Always turn the camera controller's power off when attaching or removing camera heads. Adding or removing camera heads with the power on can cause malfunction.

2.3.2. Connecting the Keypad

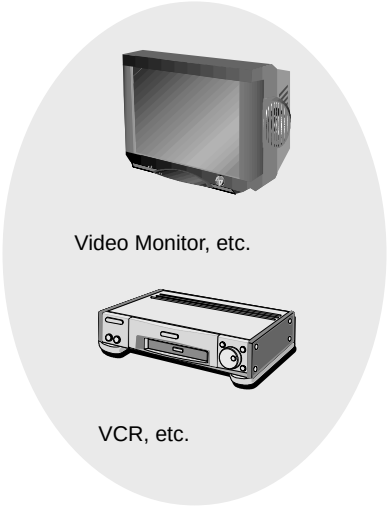
Connect the keypad connector by inserting it into the connector labeled **KEYPAD** on the front of the **camera controller.**

* The keypad is hot-pluggable. It can be plugged in and removed while the camera controller's power is on.

2.3.3. Connecting a Video Monitor

A video monitor connected to the camera controller can be used to check the **live** image **(camera pass-through image)**. With a BNC cable, connect the **VIDEO OUT** connector on the front of the camera controller to the video input on a video monitor.

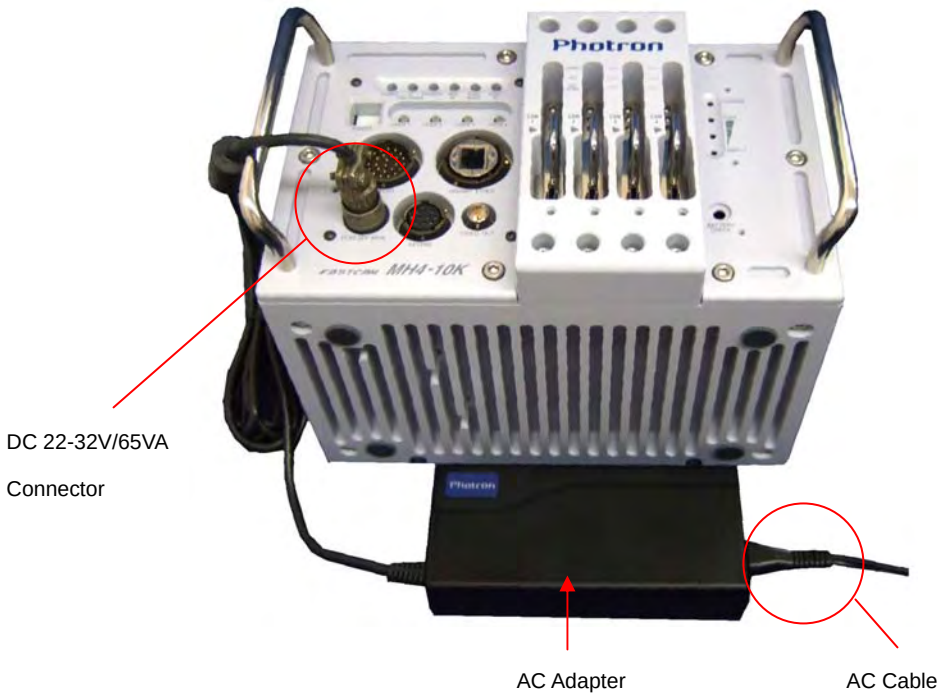
VIDEO OUT Connector



2.3.4. Connecting the AC Adapter

Connect the supplied AC adapter to a power supply.

Refer to the DC power item in section "**7.1.2. General Specifications**" for power supplies that can be used.



1. Connect the AC adapter to the **DC22 - 32V 65VA connector** on the front of the camera controller.

2. Connect the AC cable to the AC adapter.

3. Connect the AC cable to the power outlet.

2.4. Basic Keypad Operation

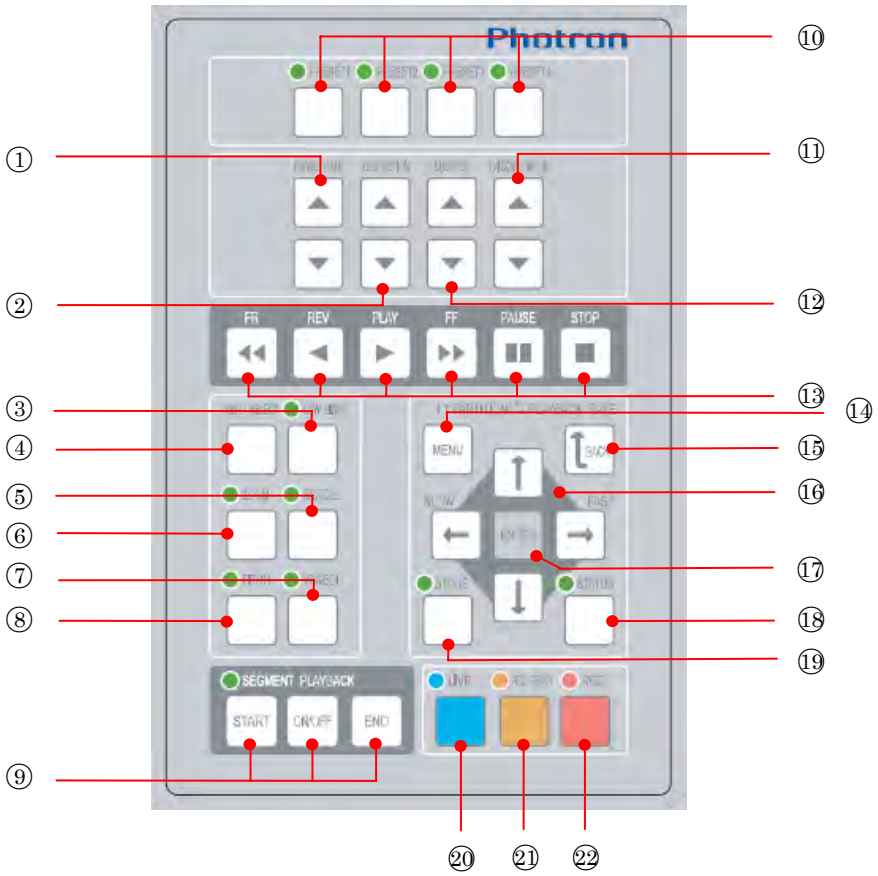
The optional keypad has been designed with the intention of making frequently repeated functions easy accessible. Detailed settings have also been organized in a menu which can be efficiently operation with using the **ARROW** keys.

This section explains the basic keypad operations when taking images with the **FASTCAM MH4-10K**.

2.4.1. Keypad Parts

■Keypad External Diagram

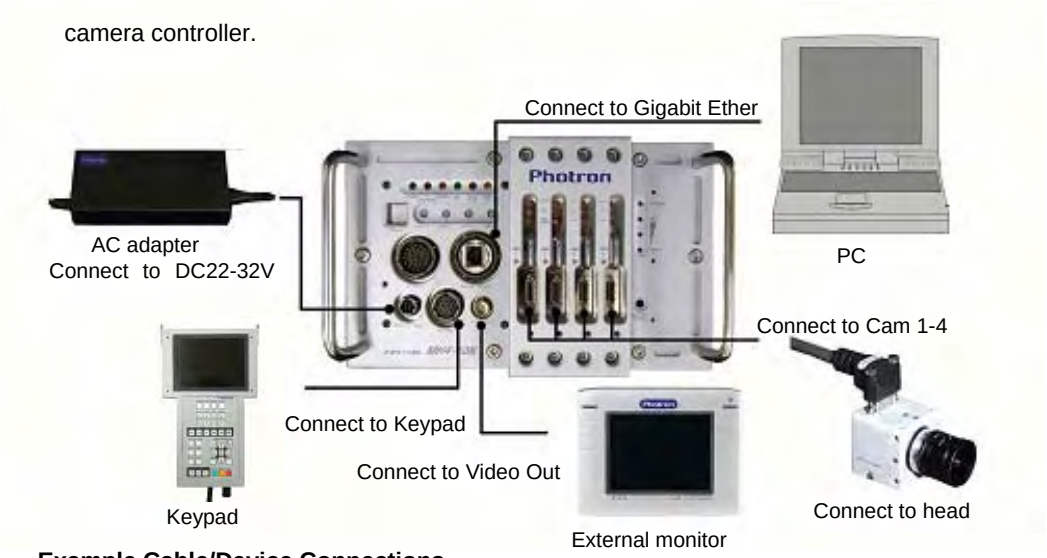
■Keypad Explanation



Num.	Key Name	Function	Num.	Key Name	Function
①	FRAME RATE	Frame Rate setting	⑫	SHUTTER	Shutter speed setting
②	RESOLUTION	Resolution setting	⑬	PLAYBACK	Playback key
③	LOW LIGHT	Low light mode	⑭	MENU	Display menu
④	HEAD SELECT	Camera head select	⑮	BACK	Setting condition return
⑤	SCROLL	Scroll	⑯	ARROW KEYS	Move up, down, left, right
⑥	ZOOM	Zoom	⑰	ENTER	Confirm key
⑦	VBS/SDI	Not used on the MH4-10K	⑱	STATUS	Display status
⑧	FIT/1:1	Display fit monitor screen/1:1	⑲	STORE	Store settings, store a marker
⑨	SEGMENT PLAYBACK	Segment playback keys	⑳	LIVE	Change LIVE/MEMORY
⑩	PRESET	Access preset	㉑	REC READY	Record ready
⑪	TRIGGER MODE	Set trigger mode	㉒	REC	Record key

2.4.2. Startup Screen

1. After attaching the camera head, cables, keypad, and external devices as explained in the previous section, turn the power on by pressing the **power switch** on the front of the camera controller.



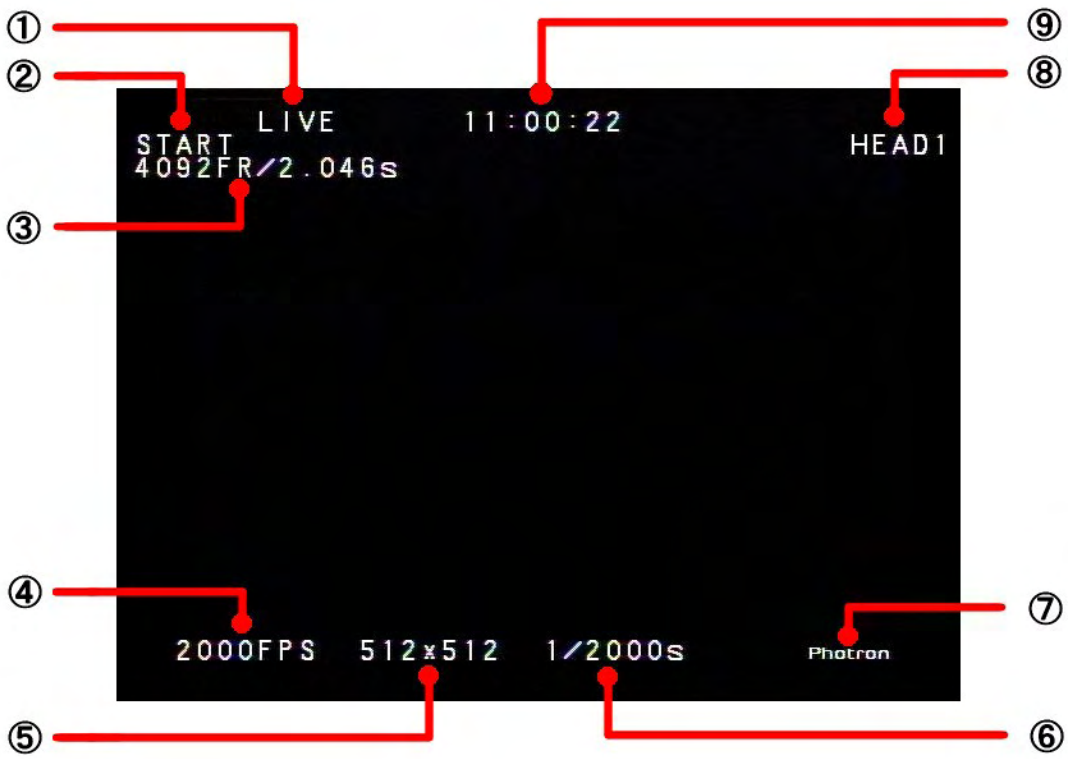
Example Cable/Device Connections

2. After switching on the power, the **camera head connection status**, **battery status**, and **current IP address setting** is displayed as text on the video monitor screen.

	Monochrome Head Connection	Color Head Connection	No Connection
Screen Display	CONNECTED MONO	CONNECTED COLOR	NOT CONNECTED

	Remaining Battery Power 100-90%	Remaining Battery Power 89-21%	Remaining Battery Power 20-0%
Screen Display	BATTERY LED GREEN	BATTERY LED YELLOW	BATTERY LED RED

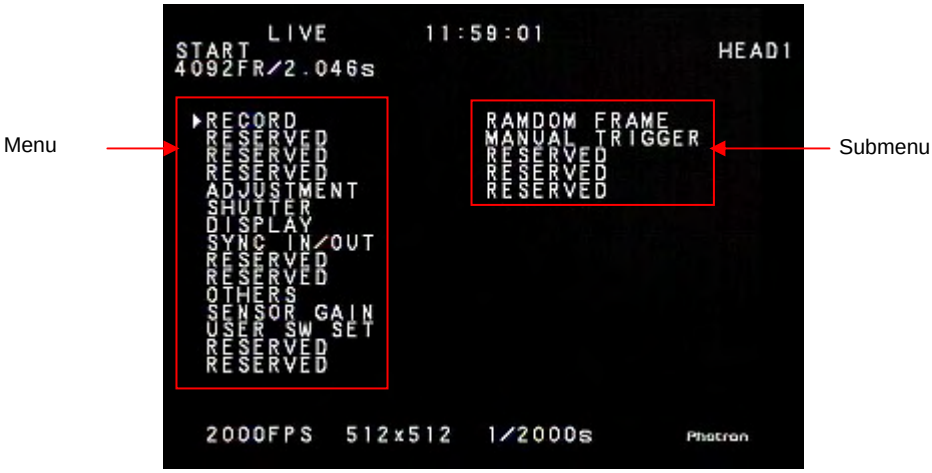
3. After a short time, a screen like the one shown below is displayed.



Num.	Explanation
①	Current display mode (LIVE mode/MEMORY playback mode)
②	The current trigger mode
③	The number of frames and the length of time that can be shot at the current setting
④	The current frame rate
⑤	The current resolution
⑥	The current shutter speed
⑦	The Photron logo
⑧	The number of the camera head currently displaying LIVE
⑨	The current time

2.4.3. Displaying the Menu List

1. The menu list is displayed on the video monitor screen by pressing the keypad **MENU** key.



Menu List Screen

2. To leave the menu list screen without making a selection (cancel), press the **MENU** key or the **BACK** key.

2.4.4. Menu Selection/Confirmation/Cancellation

The menu list has a hierarchical structure made of the “menu”, “submenu”, and “setting” layers, in that order. The cursor “ ▶ ” on the menu can be moved and the necessary menu commands can be selected by pressing the keypad **ARROW** keys.

The procedure for changing a setting is explained next.

1. Select an item on the menu using the **ARROW** ↑ ↓ (up and down) keys.

2. Find the item to set in the submenu and press the → (Right) key to move to the submenu. To return to the menu from the submenu, press the ← key.

3. Move to the item to set using the ↑ ↓ keys and press the **ENTER** key.

4. The setting item will appear on the left side of the screen that had displayed the menu. Use the **ARROW** keys to change the setting. To return to the submenu from the setting item, press the **MENU** key or the **BACK** key.

5. After changing the setting, completed your selection by pressing the **ENTER** key.

The ▶ cursor on the left side of the menu can be moved by pressing the **ARROW keys**.

2.4.5. Saving Shot Settings

After using the procedure explained in “**2.4.4. Menu Selection/Confirmation/Cancellation**” to change settings, to save your settings for the frame rate, shutter speed, and resolution explained in “**Chapter 3. Recording**”, press the keypad **STORE** key. However, use caution as the settings below will not be saved by using STORE function.

- ZOOM Settings
- FIT Settings
- LOW LIGHT Settings
- KEYPAD LCD Settings
- HEAD SELECT Settings

The following settings are saved by menu selection, regardless the use of STORE.

- Gigabit Ether IP address, net mask, gateway
- Video out NTSC/PAL selection

2.4.6. Menu/Manual Reference List

The menu has the structure shown below.

Menu	Submenu	Manual Reference Page
RECORD	RANDOM FRAME	P.60
	MANUAL TRIGGER	P.56
	RESERVED	----------
	RESERVED	----------
	RESERVED	----------
RESERVED	----------	----------
RESERVED	----------	----------
RESERVED	----------	----------
ADJUSTMENT	COLOR TEMP	P.63
	COLOR ENHANCEMENT	P.67
	LUT SELECT	P.68
	EDGE ENHANCEMENT	P.72
SHUTTER	RESERVED	----------
	RESERVED	----------
	SHUTTER MODE	P.48
DISPLAY	OSD SELECT	P.123
	CURSOR	P.123
	R/G/B	P.125
	NTSC/PAL	P.126
	KEYPAD	P.127
SYNC IN/OUT	TRIG TTL IN	P.76
	TRIG TTL OUT	P.78
	SYNC IN	P.79
	GENERAL IN	P.92
	GENARAL OUT1	P.94
	GENERAL OUT2	P.94
	GENERAL OUT3	P.94
	TRIG TTL IN DELAY	P.96
	SYNC IN DELAY	P.96
	GENERAL IN DELAY	P.96
	TRIG OUT WIDTH	P.97
	SYNC OUT DELAY	P.97
	SYNC OUT WIDTH	P.97
	EXPOSE OUT DELAY	P.97
RESERVED	----------	----------
RESERVED	----------	----------
OTHERS	DIGITAL I/F SET	P.118
	DHCP	P.119
	TIME SET	P.128
	DATE/TIME	P.122
	AUTO PLAY	P.129
	SYSTEM REV	P.131
	STATUS OUT	P.144
	RECORDING TYPE	P.100
	FACTORY DEFAULTS	P.130
SENCOR GAIN	HEAD1	P.73
	HEAD2	P.73
	HEAD3	P.73
	HEAD4	P.73
USER SW SET	USER1	P.102
	USER2	P.102
	USER3	P.102
	USER4	P.102
RESERVED	----------	----------
RESERVED	----------	----------

2.4.7. Switching the Camera head to Set/Display

A feature of the **FASTCAM MH4-10K** is its ability to do simultaneous photography from various angles using one camera controller connected to multiple camera heads. When using multiple camera heads, the camera head image to be displayed on the screen can be selected by pressing the keypad **HEAD SELECT** key.

Other than the settings listed below, settings can be made for all the cameras individually. Setting is only made for the camera head displayed.

Caution, the following settings are **common for all cameras**

・Frame Rate ・Trigger mode ・Shutter mode ・DISPLAY settings

・SYNC IN/OUT settings ・OTHERS settings ・SW SET settings

2.4.8. Saving/Accessing Camera Settings

As previously explained, settings can be made for each camera head, and a maximum of four camera configuration settings can be saved. How to save/access those settings is explained next. In addition, refer to "**Chapter 3. Recording**" for a detailed explanation of how to make the settings for each camera head.

1. On the keypad, press the numbered **PRESET** key to be set.

2. Perform the camera settings. Refer to "**Chapter 3. Recording**" for how to make the settings.

3. Press the **STORE** key. By saving the settings, the current camera settings are saved to the numbered preset selected in the first step.

4. To access the saved camera settings, press the numbered **PRESET** key that the settings were saved to.

2.4.9. Using Low Light Mode

As more you increase the frame rate or shutter speed of a high speed camera, the amount of light entering the camera decreases accordingly, making the displayed image dark. Low light mode is a function that temporarily increases the exposure time, making the displayed image easier to see. Press the **LOW LIGHT** key once to turn on low light mode. Press the **LOW LIGHT** key once more to clear low light mode. Pressing the **REC READY** key automatically clears low light mode and returns you to the selected record and shutter speed.

When in low light mode, “LOW LIGHT” will be displayed in the lower left corner of the screen, and five LEDs, all of the MAIN LEDs except the POWER LED, will blink.

2.5. Memory Backup Battery

A memory battery backup (referred to below as the battery) is built-in to the **FASTCAM MH4-10K** as standard. If the external power supply becomes disconnected, the battery can retain the contents of memory for **a maximum of about 30 minutes**. The battery is charged when the camera controller is connected to an external power supply.

The status of the battery can also be checked by pressing the **BATTERY CHECK** button, even when the power is off.

The lifespan of the battery is about one year.
However, this can change due to the environment it is used in.
To change the battery, contact Photron at the contact information listed in “9.1 Contacting Photron”.

MEMO

Chapter 3. Recording

3.1. Selecting the Frame Rate

3.2. Selecting the Resolution

3.3. Selecting the Shutter Speed

3.4. Selecting the Trigger Mode

3.5. White Balance Adjustment (Color Models Only)

3.6. Color Enhancement Adjustment (Color Models Only)

3.7. LUT (Look-Up Table) Operations

3.8. Edge Enhancement Function

3.9. Setting the Sensor Gain

3.10. External Trigger Use

3.11. Input/Output Signal Types

3.12. Using External Triggers

3.13. Using External Synchronization Signals

3.14. GENERAL Signal Settings

3.15. Signal Delay

3.16. Direct Trigger Function

3.17. Using USER SW (Programmable Switch)

3.1. Selecting the Frame Rate

Images can be captured with the **FASTCAM MH4-10K** from 60 (50 PAL) to 2000 fps using the full 512x512 pixel resolution of the image sensor. For frame rates higher than 2000 fps, high-speed photography is achieved by limiting the read area of the image sensor.

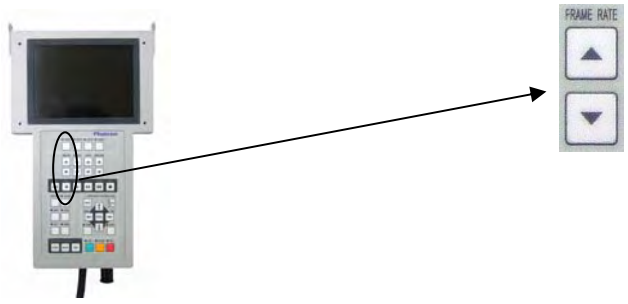
The procedure for selecting the frame rate is explained next.

The frame rate is shared by all camera heads.

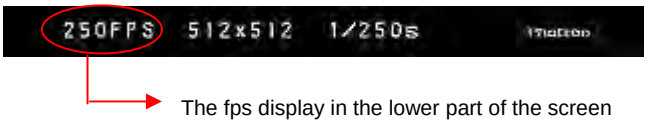
1. Verify that the camera mode is in **LIVE** mode **(the image displayed is passed through from the camera)**. If the system is in a mode other than **LIVE** mode, press the keypad **LIVE** key. When the system is in **LIVE** mode, the **LIVE** key LED will be lit.

Verify that **LIVE** is displayed at the top of the monitor.

2. Press the **FRAME RATE** ▲▼ keys. Pressing the ▲ key raises the frame rate, and pressing the ▼ key lowers the frame rate.



3. Verify that the frame rate displayed in the lower left corner of the video monitor changes as the frame rate is changed.



The fps display in the lower part of the screen changes.

4. The display of the number of frame and the time available for recording also changes at the same time.

For frame rates over 2000 fps, the resolution is automatically set to the maximum available at that frame rate. For more details, refer to “7.1.4. Frame Rate and Resolution”.

The minimum frame rate in PAL mode is **50 fps**.

The minimum frame rate in NTSC mode is **60 fps**.

3.2. Selecting the Resolution

Images with a maximum size of 260K pixels can be taken with the **FASTCAM MH4-10K** using the high-speed image sensor, which has a maximum size of 512x512 pixels. Also, by reducing the resolution, images can be taken with even faster frame rates, or the recording duration can be extended accordingly.

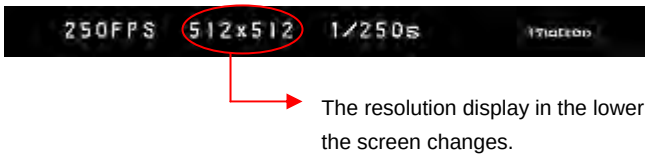
The procedure for selecting the resolution is explained next.

1. Verify that the camera mode is in **LIVE** mode.

Verify that **LIVE** is displayed at the top of the monitor.

2. Press the **RESOLUTION** ▲▼ keys. Pressing the ▲ key raises the resolution, and pressing the ▼ key lowers the resolution.

3. Verify that the resolution displayed in the lower left corner of the video monitor changes as the resolution is changed.



The resolution display in the lower part of the screen changes.

4. The display of the record time available for recording also changes at the same time.

(Reference: “7.1.4. Frame Rate and Resolution”)

3.3. Selecting the Shutter Speed

In the **FASTCAM MH4-10K**, the shutter speed is independent of the frame rate, and it is possible to control the exposure time for a recording using the electric shutter. By making an exposure that is of a shorter period than the frame rate, high-speed objects can be photographed blur-free.

Shutter speed can be set from 1/frame sec to a maximum of 1/160,000 sec (approximately 62 μ sec). (Reference: “7.1.6. Shutter Speed List”)

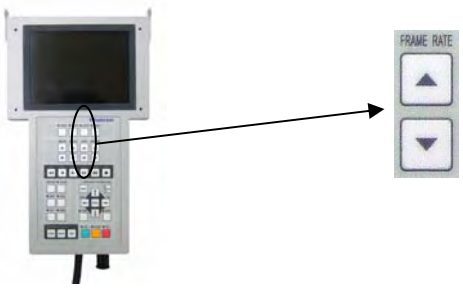
The procedure for selecting the shutter speed is explained next.

3.3.1. Setting the Shutter Speed

1. Verify that the camera mode is in **LIVE** mode.

Verify that **LIVE** is displayed at the top of the monitor.

2. Press the **SHUTTER** ▲▼ keys. Pressing the ▲ key raises the shutter speed, and pressing the ▼ key lowers the shutter speed.



3. Verify that the shutter speed displayed in the lower left corner of the video monitor changes as the shutter speed is changed.

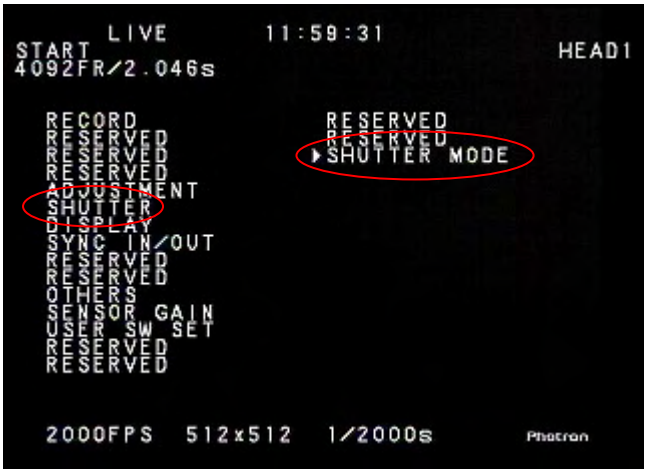
The shutter speed in the lower part of the screen changes.

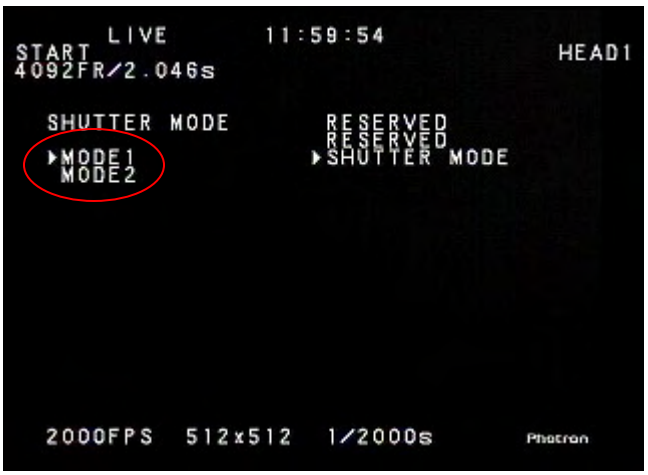
3.3.2. Changing the SHUTTER MODE

By switching between **MODE1** and **MODE2** on the **SHUTTER** menu, **SHUTTER MODE** submenu, the shutter speed's value first used when the frame rate is changed can be set.

MODE1: Changing the frame rate automatically sets the shutter speed to 1/frame sec.

MODE2: Changing the frame rate does not change the shutter speed, it maintains the current setting.





3.4. Selecting the Trigger Mode

In order to reliably capture high-speed phenomena, many kinds of trigger modes are available for the **FASTCAM MH4-10K**. These trigger modes are explained next.

* This explanation relates to the direct trigger mode setting when the "**READY AND TRIG (P.101)**" and "**AUTO PLAY (P.129)**" settings are off. If the settings differ and those settings have been turned on, the use of the system will differ from the explanation below.

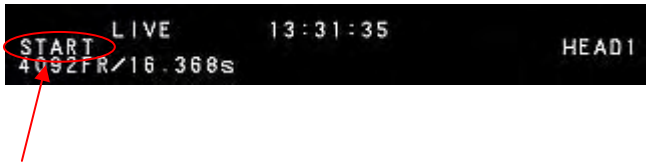
The procedure for selecting the trigger mode is explained here first. Following that is the basic explanation for using each trigger mode.

1. Verify that the camera mode is in **LIVE** mode.

Verify that **LIVE** is displayed at the top of the monitor.

2. Press the **TRIGGER MODE** ▲▼ keys. Pressing the ▲▼ keys selects the trigger mode.

3. The mode selected will be displayed on the screen immediately. Verify that the trigger mode display on the screen changes each time the key is pressed.



The trigger mode display in the upper part of the screen changes.

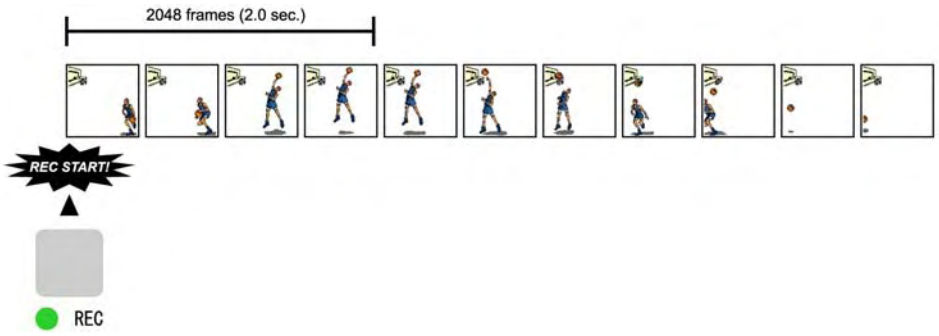
There are five types of trigger modes, listed below.

- **START**
- **CENTER**
- **END**
- **MANUAL**
- **RANDOM**

3.4.1. START Mode

START mode is a trigger mode where recording starts the instant the trigger is input, and the scene is recorded until the memory is full, and then recording ends. This mode is suitable for taking images of high-speed phenomena when what will happen, and when it happen, is known in advance. This is very useful when a trigger will be used to start both the event and the recording.

For example, in a situation with a maximum useable memory of two seconds of recording, the **REC** key is pressed as shown in the diagram below, and two seconds of high-speed video is saved immediately after the trigger is input.



▪ Recording in START Mode

The procedure for recording in **START** mode is explained next.

1. Following the directions in "**3.4. Selecting the Trigger Mode**", verify that the camera mode is in **LIVE** mode and the trigger mode is **START**.

2. Press the **REC READY** key on the keypad. The system enters the recording ready state. Verify that the **LIVE** display in the top of the screen has changed to **READY**.

3. To start recording, press the **REC** key and the trigger is input. The screen display **READY** becomes **REC** during recording, and changes to **LIVE** when recording is done.

4. Recording is finished.

3.4.2. CENTER Mode

CENTER mode is a trigger mode where equal content is recorded before and after the trigger is input is saved to memory equally. This mode is suitable for viewing before and after an important instant. For example, in a situation with a maximum useable memory for two seconds of recording, the **REC** key is pressed as shown in the diagram below, and one second before and one second after the trigger was received for a total of two seconds of high-speed video.

▪ Recording in CENTER Mode

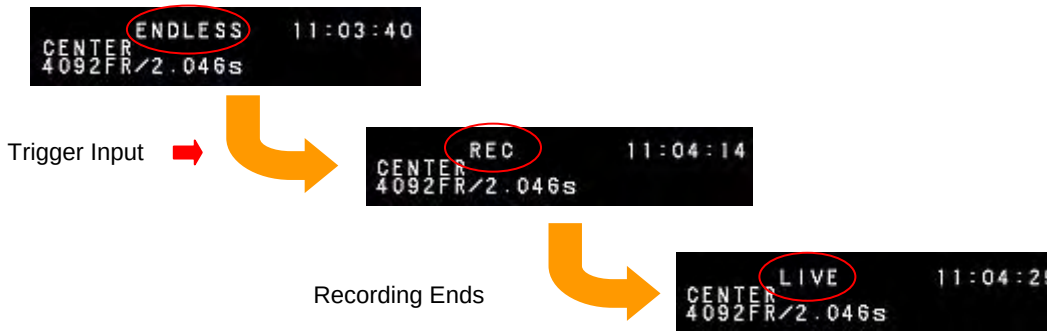
The procedure for recording in **CENTER** mode is explained next.

1. Following the directions in "**3.4. Selecting the Trigger Mode**", verify that the camera mode is in **LIVE** mode and the trigger mode is **CENTER**.

2. Press the **REC READY** key on the keypad. The system enters the recording ready state. Verify that the **LIVE** display in the top of the screen has changed to **READY**.

3. Press the **REC** key on the keypad and the trigger is input. The screen display shows **ENDLESS**. This puts the system into a state where the images are continuously written to memory in a loop.

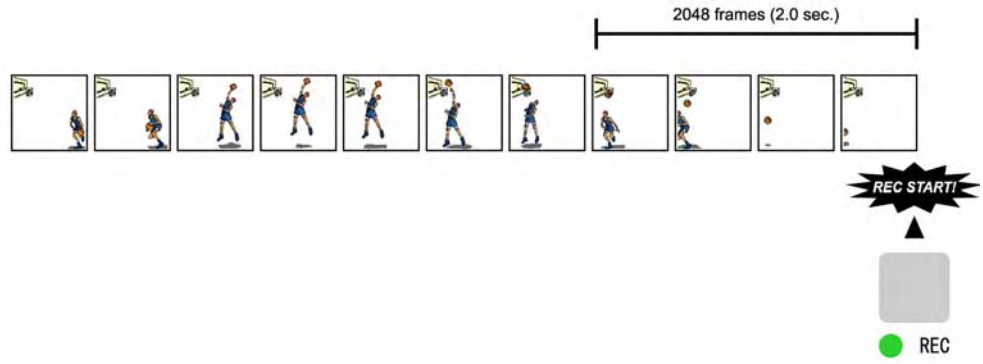
4. Press the **REC** key on the keypad again and the trigger is input. The screen display changes to **REC**. By doing this, the images before and after when the trigger was input are saved and the recording operation ends. Verify that the **REC** display has changed to **LIVE**.



5. Recording is finished.

3.4.3. END Mode

END mode is a trigger mode where the content recorded immediately before the trigger is input is saved to memory. This mode is suitable for recording a high-speed phenomenon where it is hard to predict when the important action will start and stop. For example, in a situation with a maximum useable memory for two seconds of recording, the **REC** key is pressed as shown in the diagram below, and the two seconds of high-speed video immediately before when the trigger was input are saved.



▪ Recording in END Mode

The procedure for recording in **END** mode is explained next.

1. Following the directions in "**3.4. Selecting the Trigger Mode**", verify that the camera mode is in **LIVE** mode and the trigger mode is **END**.

2. Press the **REC READY** key on the keypad. The system enters the recording ready state. Verify that the **LIVE** display in the top of the screen has changed to **READY**.

3. Press the **REC** key on the keypad and the trigger is input. The screen display shows **ENDLESS**. This puts the system into a state where the images are continuously written to memory in a loop.

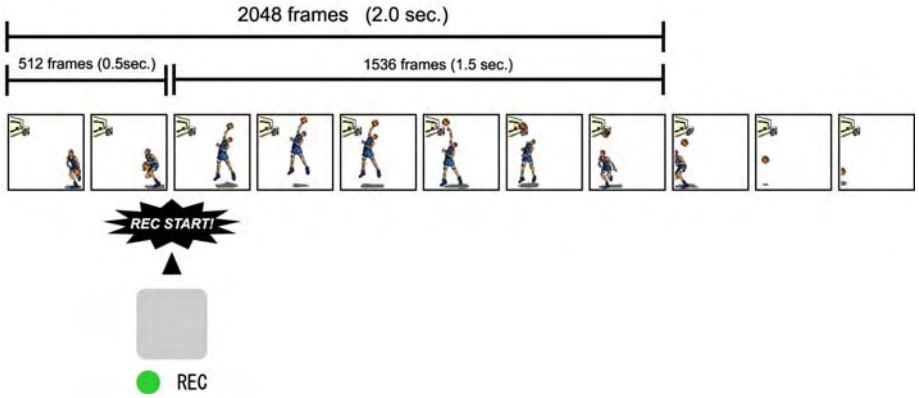
4. Press the REC key once the desired action has finished. By doing this, the images immediately before the trigger is saved, and the recording operation ends. Verify that the **ENDLESS** display in the upper part of the screen has changed to **LIVE**.

Recording Ends

5. Recording is finished.

3.4.4. MANUAL Mode

MANUAL mode is a trigger mode, similar to **CENTER** mode, where the content recorded before and after the trigger is input is saved to memory, but the proportion of time before and after the trigger can be set as required. For example, in a situation with a maximum record duration of two seconds, the system can be easily configured to save 25% of the available time before the trigger is input, and 75% after the **REC** key is pressed as shown in the diagram below, and 0.5 seconds before and 1.5 seconds after the trigger is input are recorded, and a total of two seconds of high-speed video, are saved.

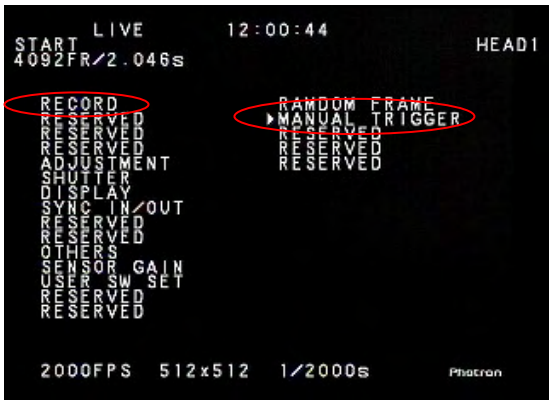


■Setting MANUAL Mode

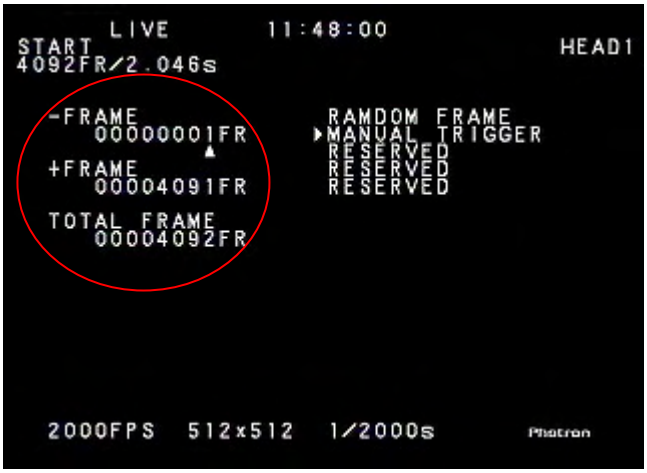
To use **MANUAL** mode, the proportion of the number frames to record before and after the trigger must be set in advance before recording. The procedure for making that setting is explained next.

1. Press the **MENU** key on the keypad and the menu list will display.

2. With the keypad **ARROW** keys, select the **MANUAL TRIGGER** from the **RECORD** submenu and confirm with the **ENTER** key.



3. The display used to specify the before/after trigger frame count is shown on the left side of the screen.



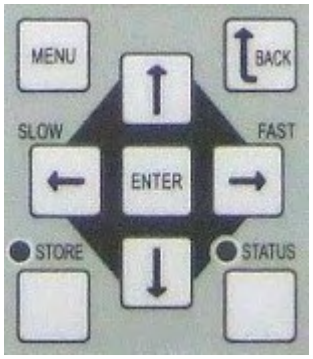
4. The meaning of each item is explained next.

-FRAME	The number of frames to saved BEFORE the trigger is received.
+FRAME	The number of frame to save AFTER the trigger is received.
TOTAL FRAME	Shows the total number of frames that can be recorded.

When -FRAME = 1, +FRAME = TOTAL FRAME-1, the same as START mode
When -FRAME = TOTAL FRAME-1, +FRAME = 1, the same as END mode
When -FRAME = +FRAME, the same as CENTER mode

5. Set the before trigger frame count. Operate the cursor with the keypad **ARROW** keys to set the desired frame count. By changing the before trigger frame count (-FRAME), the after trigger frame count (+FRAME) increases and decreases automatically in accordance with the record able frame count (TOTAL FRAME).

↑
Up
Raise/Lower Value
Down
↓



←Left Move Frame Count Digit Right→

6. When the setting is complete, press the **ENTER** key to finish. If the setting has been made correctly, for example, an after trigger frame count of 100, the trigger mode display in the upper part of the screen will show **MANUAL +100FR** as shown in the image below.

■Recording in MANUAL Mode

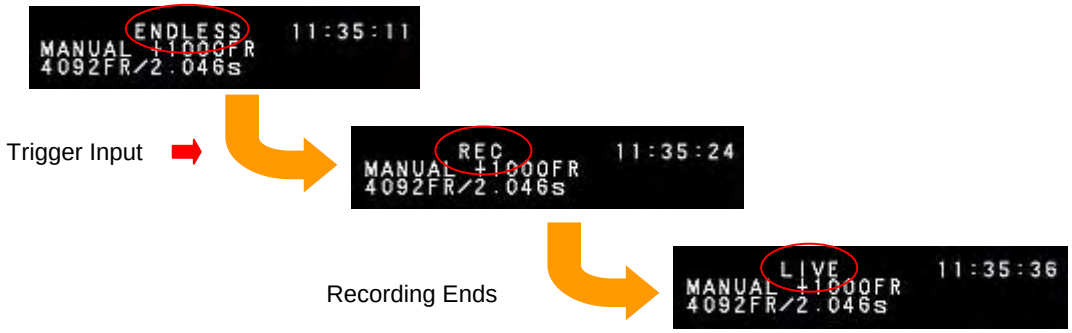
The procedure for recording in **MANUAL** mode is explained next.

1. Following the directions in "**3.4. Selecting the Trigger Mode**", verify that the camera mode is in **LIVE** mode and the trigger mode is **MANUAL**.

2. Press the **REC READY** key on the keypad. The system enters the recording ready state. Verify that the **LIVE** display in the top of the screen has changed to **READY**.

3. Press the keypad **REC** key and to input the trigger. The screen display shows **ENDLESS**. This puts the system into a state where the images are continuously written to memory in a loop.

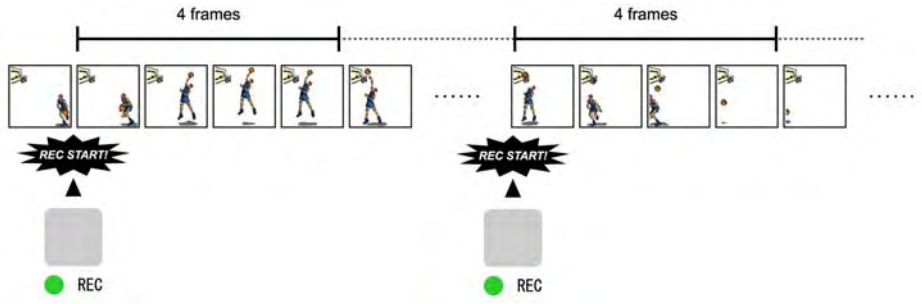
4. Press the keypad **REC** key again and the trigger is input. The screen display changes to **REC**. By doing this, the images before and after when the trigger was input are saved and the recording operation ends. Verify that the **REC** display has changed to **LIVE**.



5. Recording is finished.

3.4.5. RANDOM Mode

RANDOM mode is a trigger mode where each time a trigger is input, only a predetermined number of frames are saved to memory. For example, this function is convenient for a photographic subject which is an irregular and repeated phenomenon which can have a trigger output produced for each cycle or occurrence. The number of frames recorded each time the trigger is input can be set as desired, in one frame increments, from one frame to the maximum of all the recordable frames available.

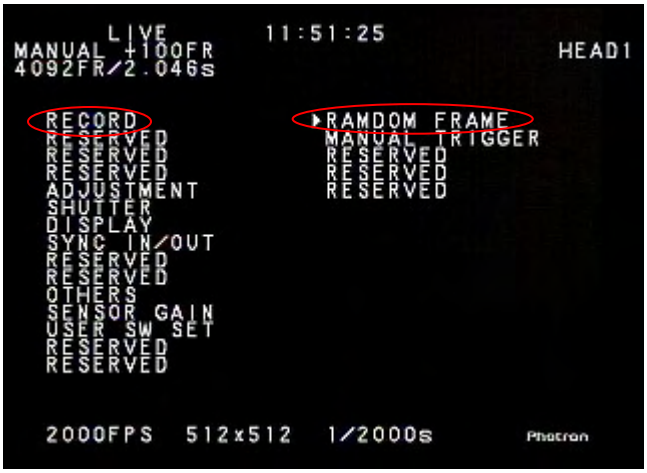


■Setting RANDOM Mode (Frame Count)

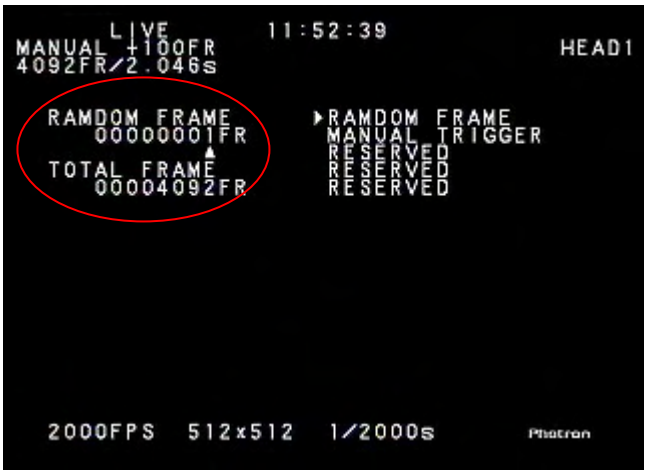
To use **RANDOM** mode, the number of frames to save each time the trigger is input must be set in advance before recording. The procedure for making that setting is explained next.

1. Press the **MENU** key on the keypad and the menu list will display.

2. With the **ARROW** keys on the keypad, select **RANDOM FRAME** from the **RECORD** submenu and confirm with the **ENTER** key.



3. The **RANDOM FRAME** menu is shown on the left side of the screen. Similar to the image below, this display is used to specify the number of frames to be recoded for each trigger.



4. Set the number of frames to save for one trigger input. Operate the cursor with the keypad **ARROW** keys to set the desired frame count.

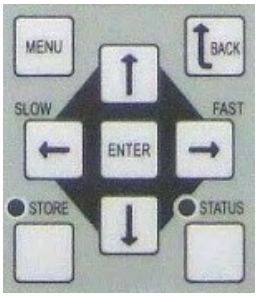
↑

Up

Raise/Lower Value

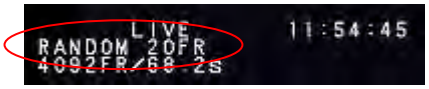
Down

↓



←Left Move Frame Count Digit Right→

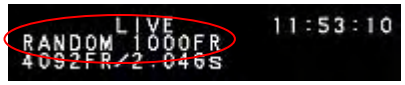
5. When the setting is complete, press the **ENTER** key to finish. If the setting has been entered correctly, For example, when the trigger has been set to save 20 frames, the trigger mode display in the upper part of the screen will show **RANDOM 20FR,** as shown in the image below.



■Recording in RANDOM Mode

The procedure for recording in **RANDOM** mode is explained next.

1. Following the directions in "**3.4. Selecting the Trigger Mode**", verify that the camera is in the **LIVE** mode and the trigger mode is **RANDOM**.



2. Press the **REC READY** key on the keypad. The system enters the recording ready state. Verify that the **LIVE** display in the top of the screen has changed to **READY**.

3. Press the **REC** key on the keypad. The screen display shows **REC**.

4. Press the **REC** key on the keypad. By doing this, the camera records only the frame count specified, and waits for the next trigger signal. Trigger signals can be input by the external trigger input connector, contact signal, or TTL signal.

("**3.11. Using External Triggers**")

The recording operation ends when the recording memory is completely consumed (*). Verify that the **REC** display has changed to **LIVE**.

* To stop during the recording operation, press the **REC READY key**.

3.5. White Balance Adjustment (Color Models Only)

On digital cameras, photographing white as pure white is described as “having the appropriate white balance.” In the **FASTCAM MH4-10K** color models as well, the white balance must be adjusted for the color temperature of the light source used, in order to take images with the correct color representation. On this system, the intensity of each color, R, G, and B, can be adjusted. By adjusting the balance of those three colors to match the light source used, the appropriate white balance can be achieved and realistic color images recorded.

Two methods are available for adjusting the white balance, preset and user-editable white balance.

Those methods are explained in this section.

3.5.1. Using Preset White Balance

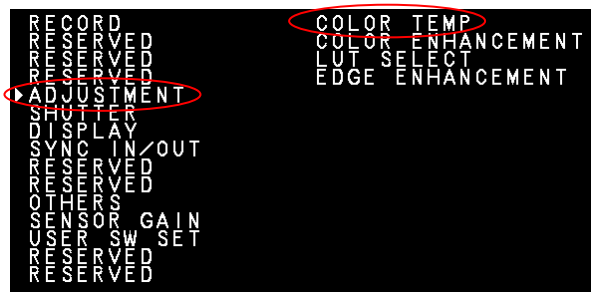
There are two types of white balance presets (5100K, 3100K) for use with common light sources. The suggested color temperature for these presets is listed below.

5100K (Daylight, Outdoors)

3100K (Halogen Light Source)

1. Press the **MENU** key on the keypad and the menu list will display.

2. Select the **COLOR TEMP** from the **ADJUSTMENT** submenu with the **ARROW** keys on the keypad and press the **ENTER** key.



3. Select 5100K (or 3100K) and press the **ENTER** key.

4. Verify that the white balance has changed on the screen.

3.5.2. Using User White Balance

Each camera head can be assigned a user white balance setting in order to achieve the most appropriate white balance for the light source used and the conditions during recording.

The values set here are stored for each camera head in the camera controller's internal memory as a user preset, and the values can be loaded by selecting **USER**.

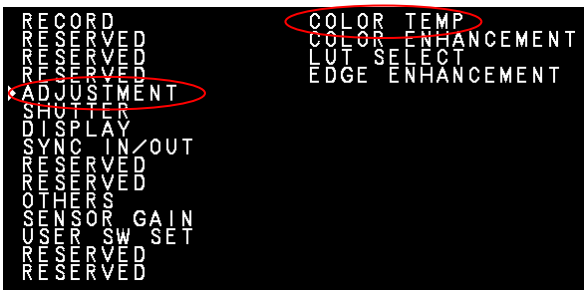
There are also two methods for setting user white balance, **AUTO USER** and **EDIT USER**. Both of these methods are explained here.

Making Settings with AUTO USER

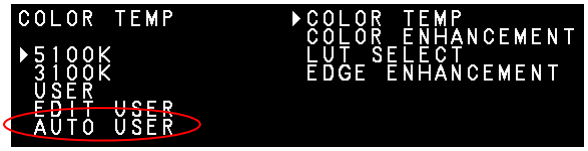
1. Set the conditions (frame rate, shutter speed, resolution) with which to record.

2. Press the **MENU** key on the keypad and the menu list will display.

3. Select the **COLOR TEMP** from the **ADJUSTMENT** submenu with the **ARROW** keys on the keypad and press the **ENTER** key.



4. Select **AUTO USER** and press the **ENTER** key to enter the white balance adjustment mode.



5. Verify that a value similar to that shown below is displayed at the bottom left of the screen.

6. Turn on the lighting to used for during the recording, and in the center of the screen, shoot an object, such as white paper, to be the white standard.

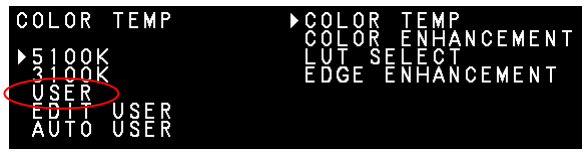
7. Adjust the lens aperture and the light intensity. Verify that the value at the bottom left of the screen changes with the intensity of the light entering the camera. If the brightness on the screen is changing but the display does not, verify that the white standard object is being shot in the middle of the screen.

8. Adjust the light intensity if **DARK** is displayed in the lower left of the screen until it changes to **PUSH ENTER KEY**. If it is too bright, **BRIGHT** is displayed, reduce the light intensity.

9. Press the **ENTER** key when the **PUSH ENTER KEY** display is shown.

10. With this operation, the camera acquires the appropriate white balance value. Verify that the display image has been adjusted.

11. The set value can be loaded by selecting **USER**.



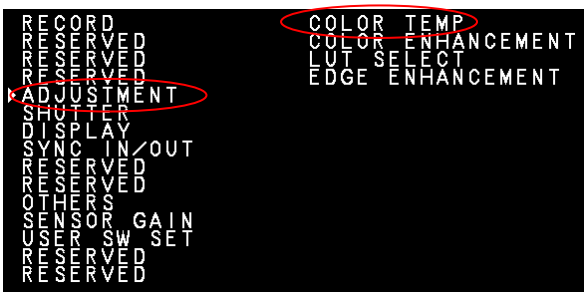
Making Settings with EDIT USER

The white balance can be set automatically, and the user can adjust the tint by changing the RGB values. The value acquired by AUTO USER can also undergo fine adjustment. The method for using **EDIT USER** to make settings is explained here.

1. Set the desired conditions (frame rate, shutter speed, resolution) with which to make recording.

2. Press the **MENU** key on the keypad and the menu list will display.

3. Select the **COLOR TEMP** from the **ADJUSTMENT** submenu with the **ARROW** keys on the keypad and press the **ENTER** key.



4. Select **EDIT USER** and press the **ENTER** key. The white balance adjustment items will display.

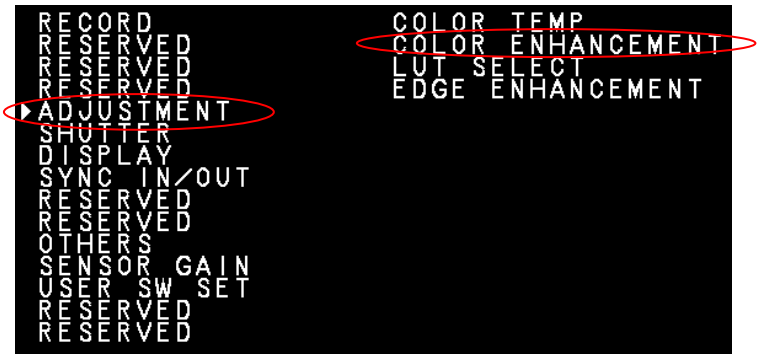
5. Use the **ARROW** keys to set the RGB values, and press the **ENTER** key to confirm when finished.

6. The set values can be loaded by selecting **USER**.

3.6. Color Enhancement Adjustment (Color Models Only)

Image color enhancement level is adjusted in five steps including OFF setting, with this setting item.

1. Press **MENU** key on the keypad, then select the **COLOR ENHANCEMENT** from the **ADJUSTMENT** submenu and press **ENTER** key.



2. The setting items are displayed. The function of each item is explained in the list below.

3. Use the ↑ ↓ **ARROW** keys to select one of the modes listed above. When finished, press the **ENTER** key to complete the setting.

Menu display	Content
OFF	Turns color enhancement mode off.
MODE1	Sets the x0.5 color enhancement.
MODE2	Sets the x1 (default) color enhancement.
MODE3	Sets the x1.5 color enhancement.
MODE4	Sets the x2 color enhancement.

3.7. LUT (Look-Up Table) Operations

The LUT (Look-Up Table) refers to a reference table that defines the relationship between the pixel brightness gradation of the original image data taken and the brightness gradation displayed on a computer screen or video monitor.

The **FASTCAM MH4-10K** contains a hardware LUT function that can display the image data taken with improved contrast (light and dark sharpness), or makes an object in the image stand out by emphasizing a specified gray level range.

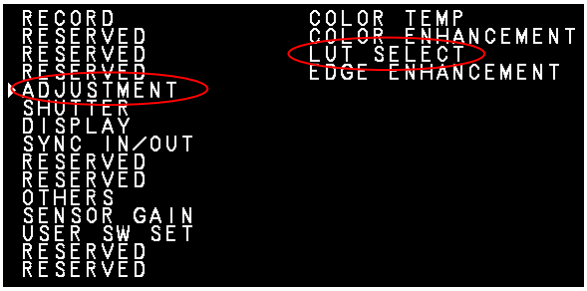
LUT in the **FASTCAM MH4-10K**, and the relationship between video output and the PC software is explained in this section.

When saving an image with the brightness converted with **LUT**, the image saved is the image that has had its brightness converted.

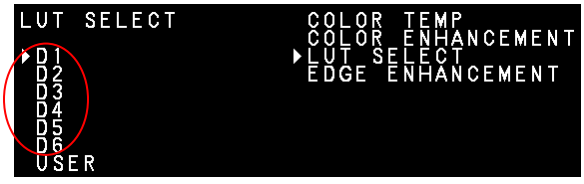
3.7.1. Using Preset LUT Patterns

Six **LUT patterns** have been preset in advance on the system. Each of these patterns is explained in this section in order.

1. Press the **MENU** key on the keypad, then select the **LUT SELECT** from the **ADJUSTMENT** submenu and press the **ENTER** key.

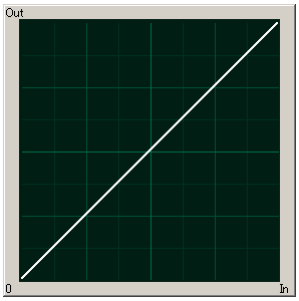


2. Select a setting, **D1** through **D6,** and that LUT setting is loaded.



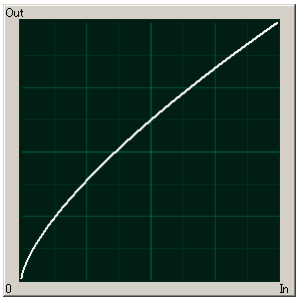
D1: GAIN 1x

The input is always linear output. This LUT is used for normal conditions.



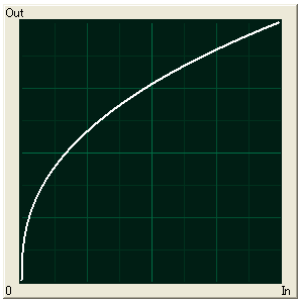
D2: Gamma 0.6

This LUT is 0.6 gamma correction.



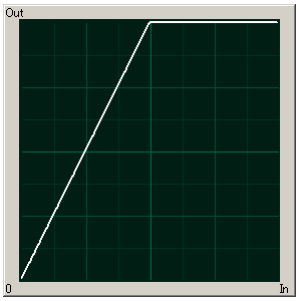
D3: Gamma 0.45

This LUT is 0.45 gamma correction.



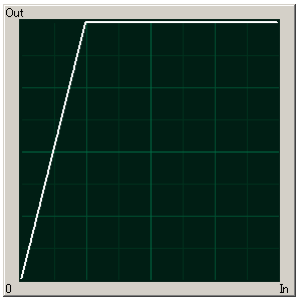
D4: Gain 2x

The upper bit from the sensor's 8-bit input is deleted, and the remaining 7-bit data is expanded to 8-bit, which emphasize the dark areas of the image.



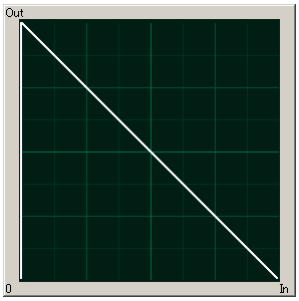
D5: Gain 4x

The upper two bits from the sensor's 8-bit input are deleted, and the remaining 6-bit data is expanded to 8-bit, which displays the dark areas of the image emphasized. This LUT emphasizes the dark portions even more than the D4 LUT.



D6: Reverse Gradation

The input gradation is reversed and then displayed.

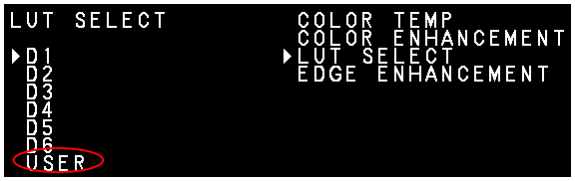


3.7.2. Using a Custom LUT

Creating a **LUT** pattern is done with the **PFV**. For details, refer to the **"PHOTRON FASTCAM Viewer User's Manual".**

About USER

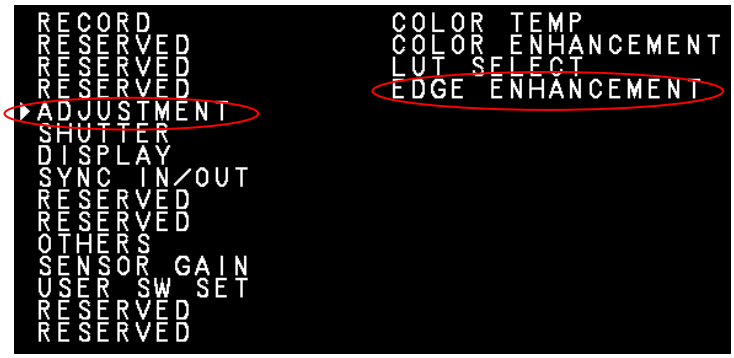
A custom LUT created with **PFV** is used.



3.8. Edge Enhancement Function

Edges within the recorded image are enhanced, in three steps, with the **FASTCAM MH4-10K's** edge enhancement setting.

1. Press the MENU key on the keypad, then select the **EDGE ENHANCEMENT** from the **ADJUSTMENT** submenu and press the **ENTER** key.



2. The setting items are displayed. The function of each item is explained in the list below.

Menu Display	Content
OFF	Turns edge enhancement mode off.
MODE1	Sets the amount of edge enhancement to light.
MODE2	Sets the amount of edge enhancement to medium.
MODE3	Sets the amount of edge enhancement to heavy.

3. Use the ↑ ↓ **ARROW** keys to select one of the modes listed above. When finished, press the **ENTER** key to complete the setting.

3.9. Setting the Sensor Gain

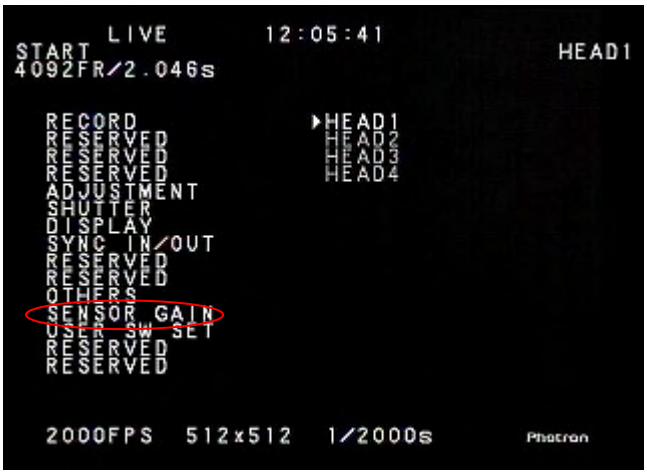
The sensor gain setting is a setting that adjusts the amplitude voltage inside the sensor. By increasing this setting, when recording in low light, the signal is amplified and the camera can take a higher gain (brighter) image. However, by amplifying the signal, the noise components also increase, resulting in decreased image quality, or more nose.

The sensor gain can be set in two steps according to the subject to be photographed.

Setting the Sensor Gain

1. Press the **MENU** key on the keypad and the menu list will display.

2. With the **ARROW** ↑ ↓ keys, select the **SENSOR GAIN** item, and press the → key to move to the submenu.



3. Select the camera head on which to make the sensor gain setting.

4. The setting items will display. Select either X1 (standard) or X3 (increased gain) with the **ARROW** ↑ ↓ keys.

5. When finished, press the **ENTER** key to confirm the setting.

3.10. Input/Output Signal Types

Many signals can be input and output with the **FASTCAM MH4-10K** using the **I/O cable**. These signals are listed below.

A signal other than the specified signal must not be input to the various connectors.

Use extreme caution as there is a risk of damage to both devices, the input device and the output device.

1. TRIG TTL IN Connector

The system recognizes an external TTL signal as a trigger during the READY or ENDLESS recording state. Starting and stopping recording (in the selected recording mode) is controlled with this signal.

Input voltage is +4.5V to +12V, positive or negative polarity, pulsewidth is 50 ns or greater.

Operating current is 10 mA recommended, 30 mA maximum.

2. TRIG TTL OUT Connector

A 5V TTL trigger signal is output for the input to an external device.

3. TRIG SW IN Connector

This trigger is input during the READY or ENDLESS recording state by contact between the BNC connector's shield and a center pin (switch closure). The center pin normally has voltage flowing through it. Use caution to avoiding contact with other pins.

4. SYNC IN Connector

The system recognizes a TTL signal from other devices as a synchronization signal.

Input voltage is +4.5V to +12V, positive or negative polarity, pulsewidth is 50 ns or greater.

Operating current is 10 mA recommended, 30 mA maximum.

5. GENERAL IN Connector

The effect when a signal is input is described below, and can be optionally selected and set. The setting is made from the menu or **PFV**. To make the setting from the menu, refer to "**3.12.1 GENERAL IN Signal Settings**". To make the setting from **PFV**, refer to the "**PHOTRON FASTCAM Viewer User's Manual**".

Input voltage is +4.5V to +12V, positive or negative polarity, pulsewidth is 50 ns or greater.

Operating current is 10 mA recommended, 30 mA maximum.

EVENT POS/NEG	:Input an event signal (event marker).
TRIG POS/NEG	:Input a TTL trigger signal.
READY POS/NEG	:Input a change recording ready status signal (READY ON/OFF).

6. GENERAL OUT (1,2,3) Connector

These are also BNC connectors. The signals below can be changed and output from the menu or **PFV**.

Refer to "**3.13.2 GENERAL OUT Signal Settings**" for details.

SYNC POS/NEG	:Output a vertical synchronization signal.
EXPOSEHEAD1 POS/NEG	:Output an exposure period signal to camera head 1.
	:Out put both during LIVE and recording.
EXPOSEHEAD2 POS/NEG	:Output an exposure period signal to camera head 2.
	:Output both during LIVE and recording.
EXPOSEHEAD3 POS/NEG	:Output an exposure period signal to camera head 3.
	:Output both during LIVE and recording.
EXPOSEHEAD4 POS/NEG	:Output an exposure period signal to camera head 4.
	:Output both during LIVE and recording.
REC POS/NEG	:Output a period signal during recording.
TRIG POS/NEG	:Output the trigger signal the camera received.
READY POS/NEG	:Output a signal that indicates the recording ready state.

3.11. Using External Triggers

Recording on the **FASTCAM MH4-10K** can be done by receiving various trigger signals matched to the recording application. The trigger signals that can be used on the **FASTCAM MH4-10K** are explained here, along with a description of how to use them.

3.11.1. Inputting an External Trigger Signal

The external trigger signals that can be used with the **FASTCAM MH4-10K**, and their input system, are listed below.

External trigger signal input settings are made by selecting **SYNC IN/OUT** from the menu, and then **TRIG TTL IN** and **GENERAL IN** from the submenu.

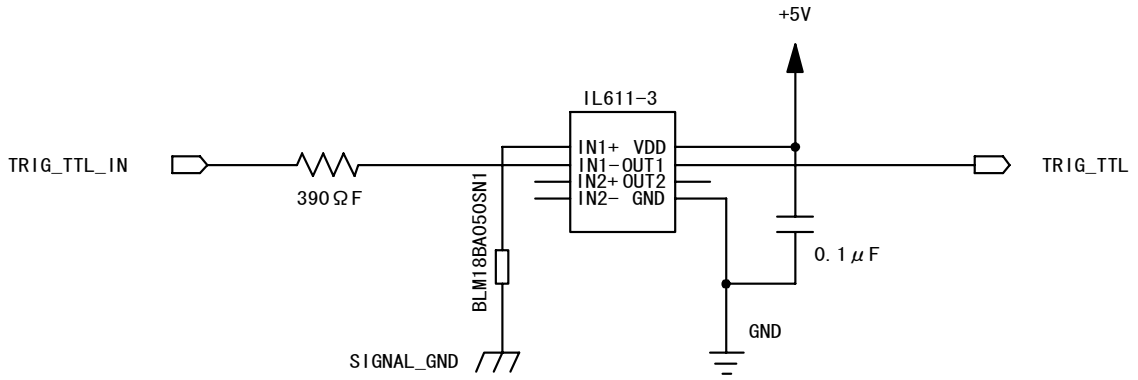
The signals are input from the **TRIG TTL IN** connector and the **GENERAL IN** connector explained in section "**2.2.9. I/O Cable**".

Connector Name (Input System)	Menu Setting	Signal
TRIG TTL IN	TRIG POS	Isolated IC Input (+4.5V - +12V), Positive Polarity
	TRIG NEG	Isolated IC Input (+4.5V - +12V), Negative Polarity
GENERAL IN	TRIG POS	Isolated IC Input (+4.5V - +12V), Positive Polarity
	TRIG NEG	Isolated IC Input (+4.5V - +12V), Negative Polarity
TRIG SW IN	(none)	Contact Signal

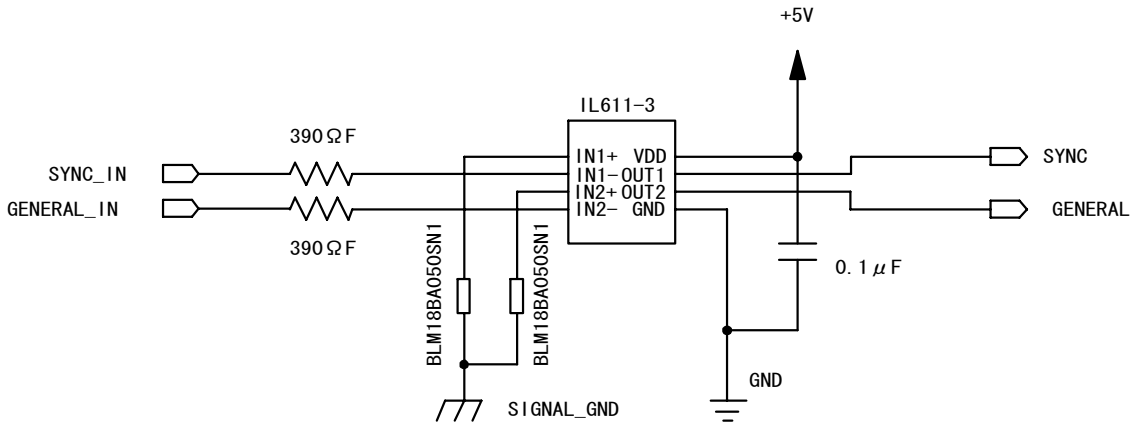
When a trigger signal is input to GENERAL IN, set the signal to be input from the menu in advance before using it. For GENERAL IN settings, refer to section "**3.13.1. GENERAL IN Signal Settings**" and make the necessary settings.

Use caution not to input more than specified voltage or current to the TRIG TTL IN and GENERAL IN trigger signal inputs as there is a risk of damage to the equipment.

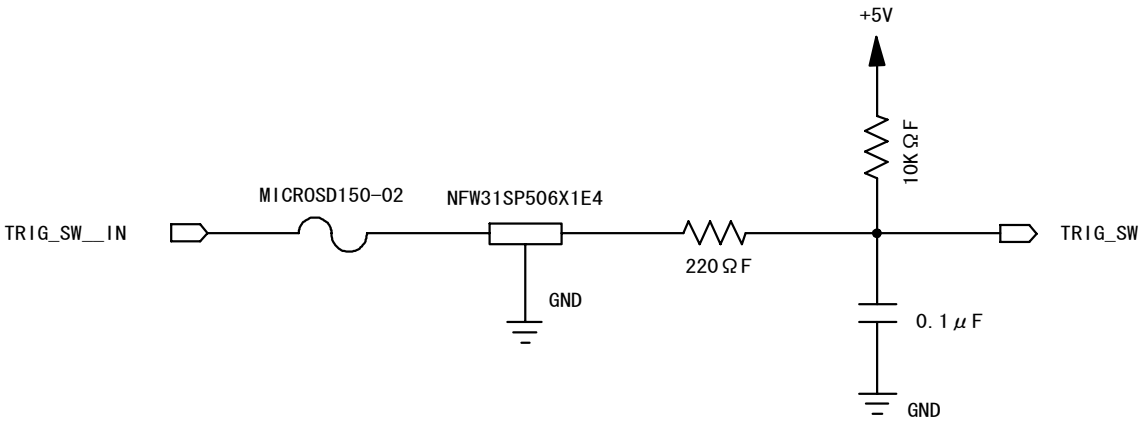
TRIG TTL IN Circuit Diagram



GENERAL IN Circuit Diagram



TRIG SW IN Circuit Diagram



3.11.2. Outputting External Trigger Signals

Trigger signals can be output externally on the **FASTCAM MH4-10K**. Output can be made with the provided **TRIG TTL OUT** connector's specialized trigger output system, and output can also be optionally set from the **GENERAL OUT** connector. External trigger signal output settings are also made by selecting **SYNC IN/OUT** from the menu, and then **TRIG TTL OUT** and **GENERAL OUT** from the submenu.

The signals are output from the **TRIG TTL OUT** connector and the **GENERAL OUT** connector explained in section "**2.2.9. I/O Cable**".

The chart below summarizes the output systems and the signals that can be output.

Connector Name (Input System)	Menu Setting	Signal Type	Reference Delay Amount
TRIG TTL OUT	TRIG POS	TTL, SW, SOFT, all TRIG pulse output CMOS (74ACT541 buffer) output, positive polarity	Approx. 40 μsec for TRIG SW IN
	TRIG NEG	TTL, SW, SOFT, all TRIG pulse output CMOS (74ACT541 buffer) output, negative polarity	Approx. 100 ns for TRIG TTL IN, GENERAL IN
	TTL IN THRU POS	TRIG TTL IN through output CMOS (74ACT541 buffer) output, positive polarity	Approx. 50 ns for TRIG TTL IN
	TTL IN THRU NEG	TRIG TTL IN through output CMOS (74ACT541 buffer) output, negative polarity	
GENERAL OUT	TRIG POS	TTL, SW, SOFT, all TRIG pulse output CMOS (74ACT541 buffer) output, positive polarity	Approx. 40 μsec for TRIG SW IN
	TRIG NEG	TTL, SW, SOFT, all TRIG pulse output CMOS (74ACT541 buffer) output, positive polarity	Approx. 100 ns for TRIG TTL IN, GENERAL IN

When a trigger signal is output to GENERAL OUT, set the signal to be output from the menu in advance before using it. For GENERAL OUT settings, refer to section "**3.13.2. GENERAL OUT Signal Settings**" and make the necessary settings.

3.12. Using External Synchronization Signals

An external synchronization mode to enable cameras to sync an external signal is provided on the **FASTCAM MH4-10K**. By using an external synchronization signal, recording can be conducted using multiple complete **FASTCAM MH4-10K** systems to synchronize the timing of the shots, or also to synchronize the shots with external measuring devices and lighting. The procedure for using the external synchronization signal is explained below.

3.12.1. Inputting an External Synchronization Signal

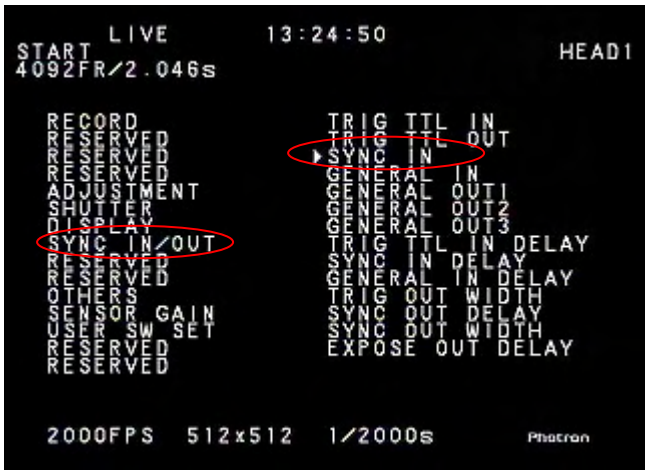
An external synchronization signal can be input on the **FASTCAM MH4-10K**. The procedure for setting external input is explained below.

1. Input the synchronization signal to the camera controller via the **SYNC IN** BNC connector as explained in section "**2.2.9. I/O Cable**".

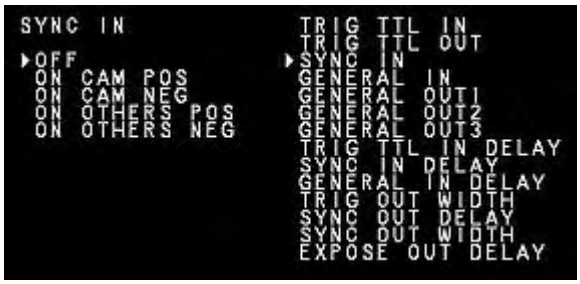
2. The LED (yellow) labeled **SYNC IN** on the front of the camera controller will light.

3. Press the **MENU** key on the keypad and the menu list will display.

4. Select the **SYNC IN** from the **SYNC IN/OUT** submenu with the **ARROW** keys and press the **ENTER** key.



5. The setting items are displayed. The content of each item is explained in the chart below.



Menu Display	Content	Signal (Input Signal Conditions)
OFF	Turns external synchronization off	(none)
ON CAM POS	Synchronize with a **FASTCAM MH4-10K**	TTL level, positive polarity
ON CAM NEG	Synchronize with a **FASTCAM MH4-10K**	TTL level, negative polarity
ON OTHERS POS	Synchronize with an external device (including other Photron products)	TTL level, positive polarity
ON OTHERS NEG	Synchronize with an external device (including other Photron products)	TTL level, negative polarity

6. Select the menu to set with the **ARROW** ↑ ↓ keys.

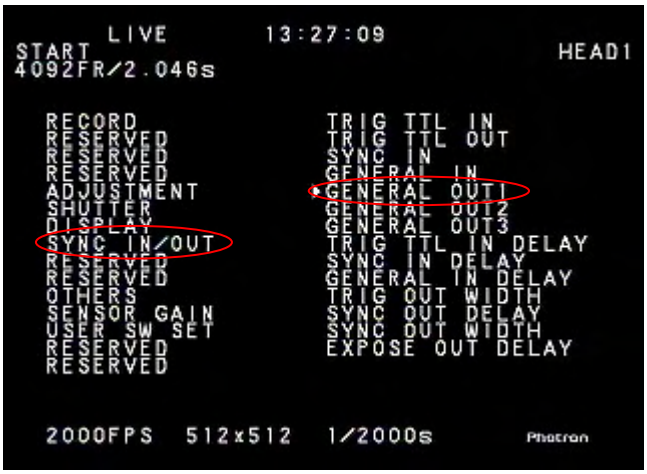
7. When finished, press the **ENTER** key to complete the setting.

3.12.2. Outputting an External Synchronization Signal

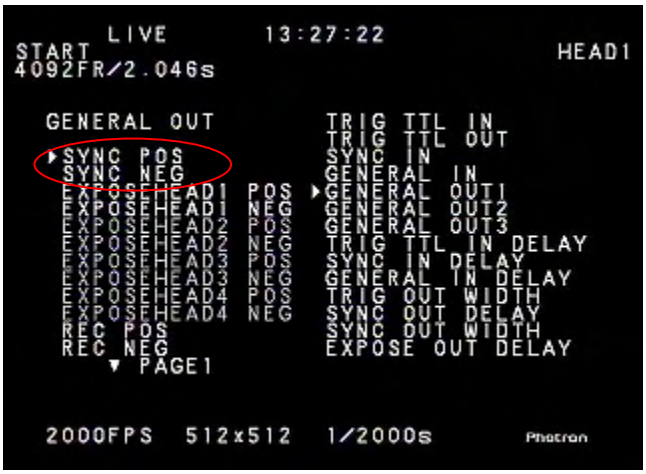
A synchronization signal can be output externally on the **FASTCAM MH4-10K**. The external synchronization signal is output from the GENERAL OUT connector explained in section "**2.2.9. I/O Cable**". The procedure for setting external synchronization signal output is explained below.

1. Press the **MENU** key on the keypad and the menu list will display.

2. Select the **GENERAL OUT1** (When setting the **GENERAL OUT2** connector, **GENERAL OUT2**) from the **SYNC IN/OUT** submenu with the **ARROW** keys.



3. The menu is displayed. When performing external synchronization, use either **SYNC POS** or **SYNC NEG**. View the chart on the next page for details.



Menu Display	Content	Signal Type	Reference (Input/Output Delay Amount)
SYNC POS	Outputs a vertical synchronization signal with positive polarity.	CMOS (74ACT541 buffer) Output, Positive Polarity	Approx. 100 ns
SYNC NEG	Outputs a vertical synchronization signal with negative polarity.	CMOS (74ACT541 buffer) Output, Negative Polarity	Approx. 100 ns

4. Select the output signal with the **ARROW** ↑ ↓ keys.

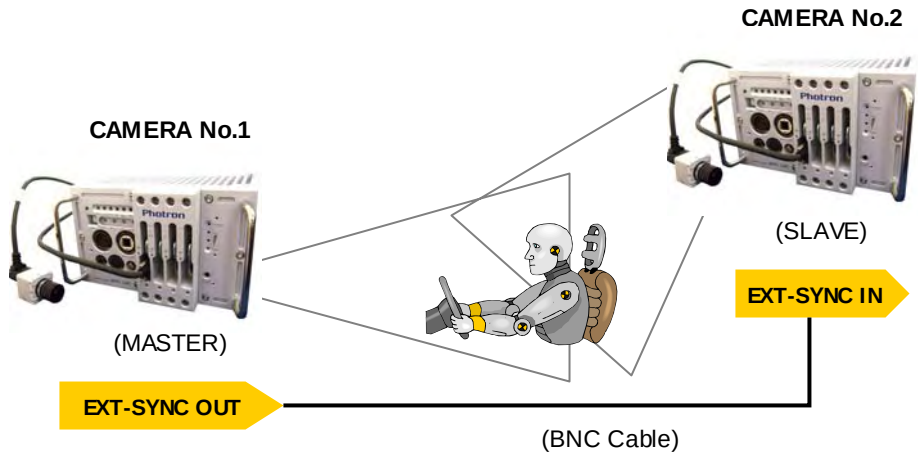
5. When finished, press the **ENTER** key to complete the setting.

3.12.3. Synchronizing Multiple FASTCAM MH4-10K Systems

On the **FASTCAM MH4-10K**, up to a maximum of four camera heads can be attached to one camera controller, and those camera heads are completely synchronized internally by the camera controller.

Using an external synchronization input and output, multiple camera controllers can be synchronized, allowing synchronized shots using more than four camera heads.

Conceptual Diagram of a Synchronized Connection



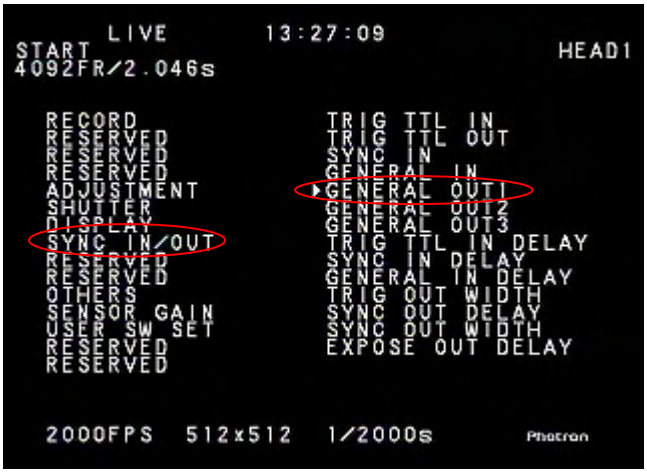
The external synchronization signal settings are explained here for when it is necessary to use two **FASTCAM MH4-10K** system to take simultaneous shots with a maximum of eight camera heads.

Setting the Master Camera Controller (Synchronization Output Controller)

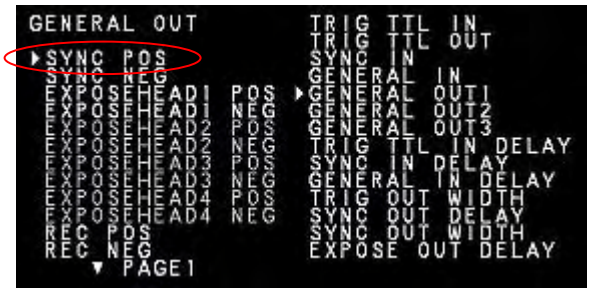
First, decide on which camera controller will be the master, then set it to output the synchronization signal.

1. Press the **MENU** key on the keypad and the menu list will display.

2. Select the **GENERAL OUT1** from the **SYNC IN/OUT** submenu with the **ARROW** keys on the keypad.



3. Select the signal to be output from the master camera controller's **GENERAL OUT1** connector from the menu. Move the cursor to the **SYNC POS** item with the **ARROW** ↑ ↓ keys and press the **ENTER** key to select.



4. The system has been set to output a positive polarity vertical synchronization signal from the master camera controller's **GENERAL OUT1** connector.

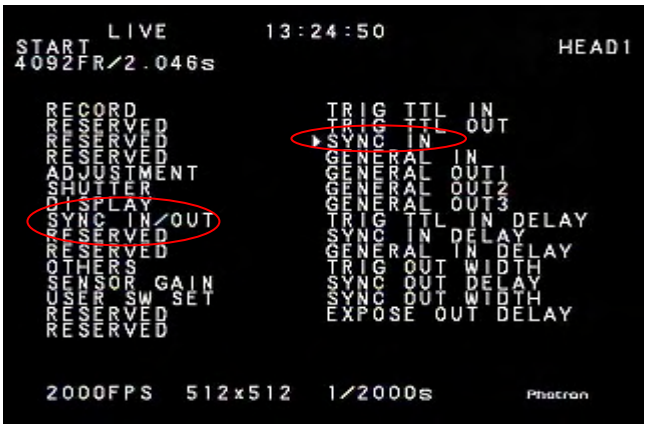
Setting the Slave Camera Controller (Synchronization Signal Receiving Controller)

Next, set the synchronization signal input of the slave camera controller which will receive the synchronization signal supplied by the master camera controller.

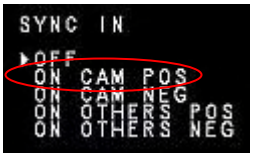
1. Input the slave camera controller's synchronization to the master camera controller.
   Connect the master camera controller's **GENERAL OUT1** connector and the slave camera controller's **SYNC IN** connector using a BNC cable.
   When the synchronization signal is input to the **SYNC IN** connector, the **SYNC IN LED** (yellow) on the front of the slave camera controller will light.

2. Set the synchronization signal type that slave camera controller will receive. Press the **MENU** key on the keypad and the menu list will display.

3. Select the **SYNC IN** from the **SYNC IN/OUT** submenu with the **ARROW** keys.



4. The output previously set on the master camera controller has positive polarity (POSITIVE), therefore it is necessary to make the setting on the slave camera controller the same, positive polarity (POSITIVE). Move the cursor to the **SYNC POS** item with the **ARROW** ↑ ↓ keys, and press the **ENTER** key to select.



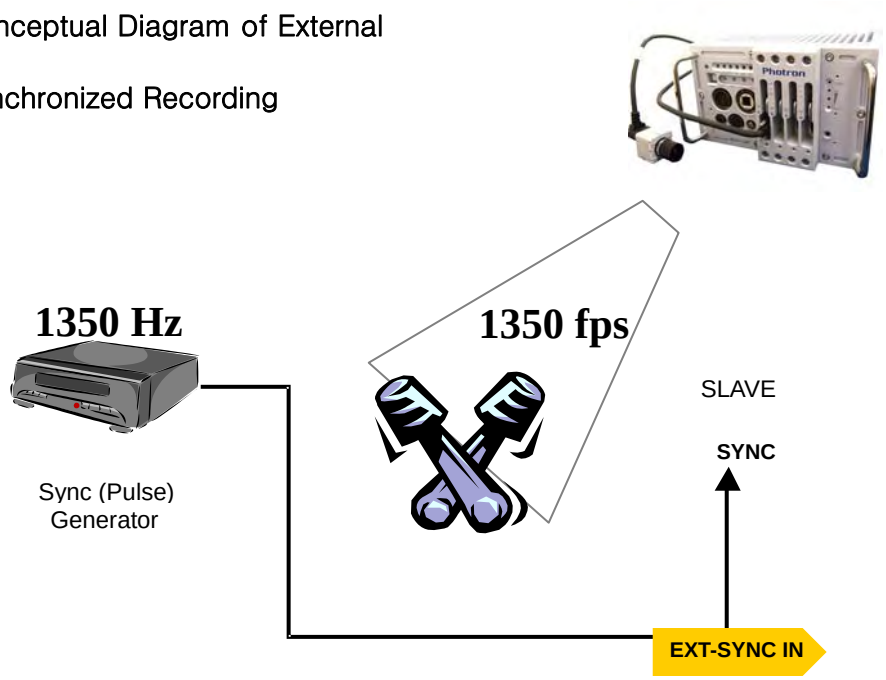
If steps 2-4 are completed when no synchronization signal is being input, the display shows "**NO SYNC INPUT**".

3.12.4. Synchronizing the FASTCAM MH4-10K with Other External Devices (Frame Rate Synchronization Recording)

On the **FASTCAM MH4-10K**, in addition to the frame rate set on the camera, a function has been provided that can record by receiving an external synchronization signal after setting the frame rate to the frequency of the signal.

In this way, as an example, the **FASTCAM MH4-10K** can be synchronized with a dynamic body that spins at 1350 revolutions a second to conduct high-speed recording at 1350 fps. This can open up broad applications that were unavailable until now.

Conceptual Diagram of External Synchronized Recording



Synchronization Signals That Can Be Input

When conducting frame rate synchronization recording on the **FASTCAM MH4-10K**, the signal that can be input must meet the following conditions.

- TTL level, positive polarity or negative polarity
- 60 Hz (50 Hz for PAL) to 10,000 Hz

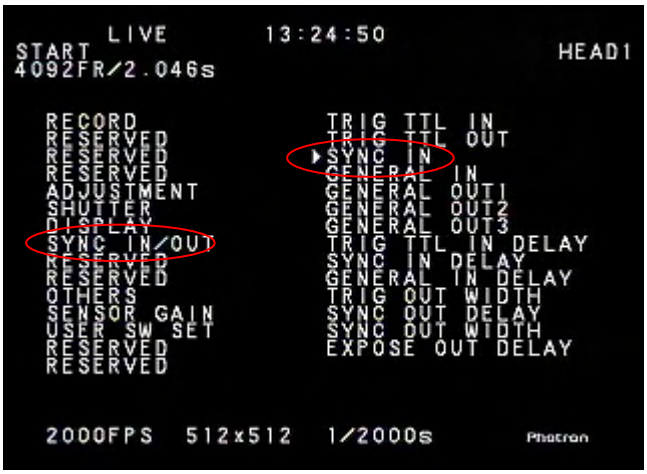
Camera Settings

1. Input the synchronization signal from the device to be recorded into the camera. Connect the synchronizing device's output signal to the camera controller's **SYNC IN** connector using a BNC cable.

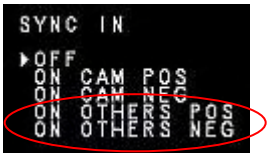
2. When the synchronization signal is input to the **SYNC IN** connector, the **SYNC IN LED** (yellow) on the front of the camera controller will light.

3. Press the **MENU** key on the keypad and the menu list will display.

4. Select the **SYNC IN** from the **SYNC IN/OUT** submenu with the **ARROW** keys.



5. Select the input signal with the **ARROW** ↑ ↓ keys. Select **ON OTHERS POS** (positive polarity) or **ON OTHERS NEG** (negative polarity) according to the polarity of the external synchronization signal.



6. When finished, press the **ENTER** key to complete the setting.

7. Output the signal from the synchronization device, and verify that the camera recognizes the output frequency and synchronizes its frame rate. The recognized frame rate will display in the lower left of the video monitor.

The frequency of the synchronization signal cannot be changed during the LIVE or recording state. (This is out of spec assurance.)

The synchronization signal can be changed if you repeat steps 1 through 7 after changing the frequency.

If no synchronization signal is input, or the input signal is under 60Hz (50Hz), during steps 3-7, the display shows "**NO SYNC INPUT**".
The display will show 1 fps, which indicates that there is no synchronization signal present.

If steps 3 through 7 are set with inputing signal over 10000Hz, the display shows "**OVER SYNC INPUT**".

The LED on the front of the camera controller indicates that the synchronization signal is being input. If the synchronization signal is lost, the LED will extinguish.

A minute error occurs in the input synchronization signal due to the construction of the internal circuitry of this function.
For the FASTCAM MH4-10K, an error of ±1 Hz can occur.
For example, when performing external device synchronization inputting a synchronization signal of 10000Hz, the error is: 10000 Hz ±1 Hz = 9999 fps to 10001 fps.

3.12.5. Synchronizing the FASTCAM MH4-10K with Other Cameras (Mixed-Type Synchronization Recording)

Using the previous section's "**3.12.4 Synchronizing the FASTCAM MH4-10K with Other External Devices**" function (frame rate synchronization recording), mixed-type synchronized recording can be performed with Photron's other high-speed cameras, the **FASTCAM-ultima APX-RS,** the **FASTCAM-ultima APX**, the **FASTCAM-ultima 512**, and the **FASTCAM-ultima1024 R2.**

■Synchronizing the FASTCAM MH4-10K with the FASTCAM-ultima APX-RS, the FASTCAM-ultima APX, and the FASTCAM-ultima 512

The procedure for synchronizing the **FASTCAM MH4-10K** with the **FASTCAM-ultima APX-RS,** the **FASTCAM-ultima APX,** and the **FASTCAM-ultima 512** is explained here.

The external connector's specifications on the camera controller's rear panel and the remote control operating environment on the **FASTCAM-ultima APX-RS,** the **FASTCAM-ultima APX**, and the **FASTCAM-ultima 512** are nearly the same. Therefore, it is possible to change the settings on each device in a similar manner.

For this example, assume that the master camera is the **FASTCAM MH4-10K** and the slave camera is the **FASTCAM-ultima APX-RS.**

◇Setting the Master Camera (Synchronization Output Camera)

First, set the synchronization signal output for the master camera, the **FASTCAM MH4-10K**.

1. Press the **MENU** key on the keypad and the menu list will display.

2. Move the cursor to **GENERALOUT1** from the **SYNC IN/OUT** submenu with the **ARROW** keys on the keypad, and press the **ENTER** key to select.

3. From the menu, select the signal to output from the master camera's **GENERAL OUT1** connector. Move the cursor to the **SYNC POS** item with the **ARROW** ↑ ↓ keys, and press the **ENTER** key to select.

4. The master camera is set to output a positive polarity vertical synchronization signal from its **GENERAL OUT1** connector.

◇Setting the Slave Camera (Synchronization Signal Receiving Camera)

Set the synchronization signal input for the slave camera controller, the **FASTCAM-ultima APX-RS.**

1. Input the master camera's synchronization signal to the slave camera controller. Connect the master camera's **GENERAL OUT1** connector and the slave camera controller's **EXT-SYNC IN** connector using a BNC cable. When the synchronization signal is input to the **SYNC IN** connector, the **Power LED** (Green) on the rear of the slave camera controller will light.

2. Set the synchronization signal type that slave camera controller will receive. Press the **MENU** key on the keypad and the menu list will display.

3. Select the **EXT-SYNC IN** with the **ARROW** keys, and press the **ENTER** key.

4. The output previously set on the master camera has positive polarity (POSITIVE), therefore it is necessary to make the setting on the slave camera controller the same, positive polarity (POSITIVE). Move the cursor to the **ON POS OTHERS** item with the **ARROW** ↑ ↓ keys, and press the **ENTER** key to select.

■Synchronizing the FASTCAM MH4-10K with the FASTCAM-ultima1024 R2

When synchronizing the **FASTCAM MH4-10K** with the **FASTCAM-ultima1024 R2**, the master camera is the **FASTCAM-ultima1024 R2** and the slave camera is the **FASTCAM MH4-10K**.

The FASTCAM-ultima1024 R2 has no function (frame rate synchronization recording function) to be synchronized by external devices, therefore, the FASTCAM-ultima1024 R2 cannot be synchronized as a slave to the FASTCAM MH4-10K.

◇Setting the Master Camera (Synchronization Output Camera)

First, set the synchronization signal output for the master camera, the **FASTCAM-ultima1024 R2**.

1. Press the **MENU** key on the keypad and the menu list will display.

2. Move the cursor to **EXT OUT** item with the **ARROW** ↑ ↓ keys on the keypad, and press the **ENTER** key to select.

3. From the menu, select the signal to output from the master camera's **EXT OUT** connector. Move the cursor to the **SYNC POS** item with the **ARROW** ↑ ↓ keys, and press the **ENTER** key to select.

4. The master camera is set to output a positive polarity vertical synchronization signal from its **EXT OUT** connector.

◇Setting the Slave Camera (Synchronization Signal Receiving Camera)

Next, set the synchronization signal input for the slave camera controller, the **FASTCAM MH4-10K.**

1. Input the master camera's synchronization signal to the slave camera controller. Connect the master camera's **EXT OUT** connector and the slave camera controller's **SYNC IN** connector using a BNC cable. When the synchronization signal is input to the **SYNC IN** connector, the **SYNC IN LED** (yellow) on the front of the slave camera controller will light.

2. Set the synchronization signal type that slave camera controller will receive. Press the **MENU** key on the keypad and the menu list will display.

3. Select the **SYNC IN** from the **SYNC IN/OUT** submenu with the **ARROW** keys on the keypad, and press the **ENTER** key.

4. The output previously set on the master camera has positive polarity (POSITIVE), therefore it is necessary to make the setting on the slave camera controller the same, positive polarity (POSITIVE). Move the cursor to the **ON OTHERS POS** item with the **ARROW** ↑ ↓ keys, and press the **ENTER** key to select.

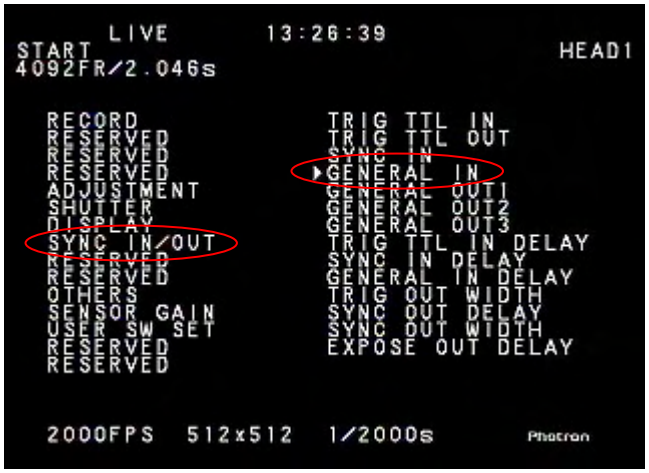
3.13. GENERAL Signal Settings

3.13.1. GENERAL IN Signal Settings

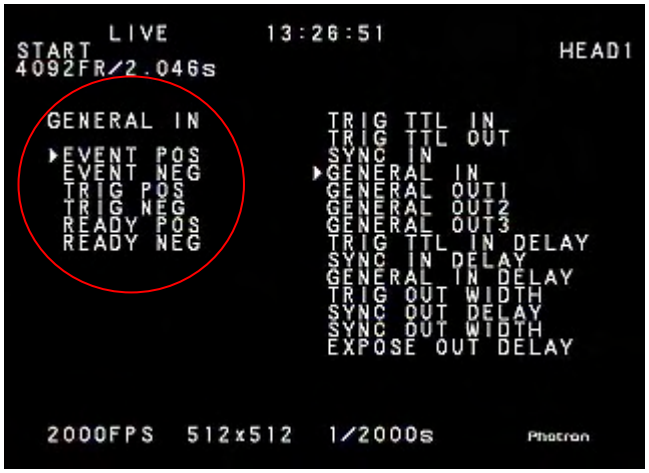
Select a signal for outputs from the **GENERAL IN** connector as explained in section "**3.10. Input/Output Signal Types**".

1. Press the **MENU** key on the keypad and the menu list will display.

2. Select the **GENERAL IN** from the **SYNC IN/OUT** submenu with the **ARROW** keys on the keypad and press the **ENTER** key.



3. The **GENERAL IN** menu is displayed. The content of the various items is listed in the chart below.



Menu Display	Content	Reference (Input Signal Conditions)
EVENT POS	Input a positive polarity event signal.	TTL Level, Positive Polarity
EVENT NEG	Input a negative polarity event signal.	TTL Level, Negative Polarity
TRIG POS	Input a positive polarity trigger signal.	TTL Level, Positive Polarity
TRIG NEG	Input a negative polarity trigger signal.	TTL Level, Negative Polarity
READY POS	Input a positive polarity READY signal. The camera's READY ON/OFF is switched by a pulse input.	TTL Level, Positive Polarity
READY NEG	Input a negative polarity READY signal. The camera's READY ON/OFF is switched by a pulse input.	TTL Level, Negative Polarity

When using as a part of a system, verify the characteristics of the input signals before using them.

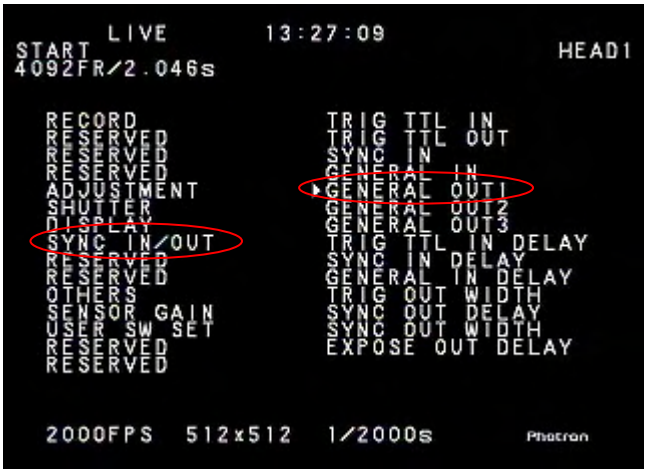
For details on the EVENT POS/NEG setting, refer to "3.15. Event Marker Function".

3.13.2. GENERAL OUT Signal Settings

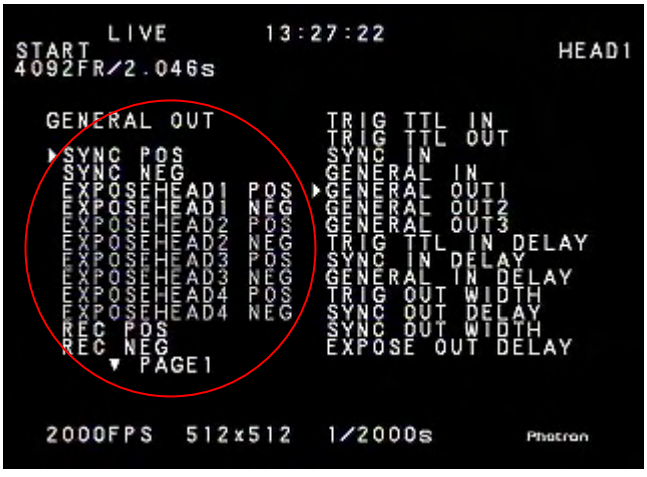
Select a signal for outputs from the **GENERAL OUT** connector as explained in section "**3.10. Input/Output Signal Types**". There are three **GENERAL OUT** connectors, and settings can be made for each connector individually.

1. Press the **MENU** key on the keypad and the menu list will display.

2. Select the **GENERAL OUT1** (When setting connector 2, select **GENERAL OUT2**) from the **SYNC IN/OUT** submenu with the **ARROW** keys on the keypad and press the **ENTER** key.



3. The **GENERAL OUT1** menu is displayed. The content of the various items is listed in the chart below.



Menu Display	Content	Signal Type
SYNC POS	Output a positive polarity vertical synchronization signal.	
SYNC NEG	Output a negative polarity vertical synchronization signal.	
EXPOSEHEAD1 POS	Output camera head 1's image sensor's exposure period at H level.	TTL Level, Positive Polarity
EXPOSEHEAD1 NEG	Output camera head 1's image sensor's exposure period at L level.	TTL Level, Negative Polarity
EXPOSEHEAD2 POS	Output camera head 2's image sensor's exposure period at H level.	TTL Level, Positive Polarity
EXPOSEHEAD2 NEG	Output camera head 2's image sensor's exposure period at L level.	TTL Level, Negative Polarity
EXPOSEHEAD3 POS	Output camera head 3's image sensor's exposure period at H level.	TTL Level, Positive Polarity
EXPOSEHEAD3 NEG	Output camera head 3's image sensor's exposure period at L level.	TTL Level, Negative Polarity
EXPOSEHEAD4 POS	Output camera head 4's image sensor's exposure period at H level.	TTL Level, Positive Polarity
EXPOSEHEAD4 NEG	Output camera head 4's image sensor's exposure period at L level.	TTL Level, Negative Polarity
REC POS	Output a period signal during recording at H level.	TTL Level, Positive Polarity
REC NEG	Output a period signal during recording at L level.	TTL Level, Negative Polarity
TRIG POS	Output the trigger signal the camera controller received at H level.	TTL Level, Positive Polarity
TRIG NEG	Output the trigger signal the camera controller received at L level.	TTL Level, Negative Polarity
READY POS	Output at H level when in a state waiting for the REC trigger (If in START mode, READY, CENTER, END; If in MANUAL, the ENDLESS recording state). Only valid in START, CENTER, END, and MANUAL mode.	TTL Level, Positive Polarity
READY NEG	Output at L level when in a state waiting for the REC trigger (If in START mode, READY, CENTER, END; If in MANUAL, the ENDLESS recording state). Only valid in START, CENTER, END, and MANUAL mode.	TTL Level, Negative Polarity

When using as a part of the system,

Verify the characteristics of the output signals before using them.

3.14. Signal Delay

A signal delay time or pulsewidth for the various signals that are input and output can be set on the **FASTCAM MH4-10K.** The procedure for making these settings is explained here.

■**TRIG TTL IN DELAY** Setting Range: 0-60 (s), in 100 ns units

Set from the **SYNC IN/OUT** submenu, **TRIG TTL IN DELAY**.

A pre-specified delay is implemented from the instant the trigger signal is input, the camera will recognize and respond to the trigger input only after the specified amount of time set has elapsed. Increase or decrease the value with the **ARROW** ↑ ↓ keys, move the digit with the ←→ keys.

■**SYNC IN DELAY** Setting Range: 0-1/frame rate (s), in 100 ns units

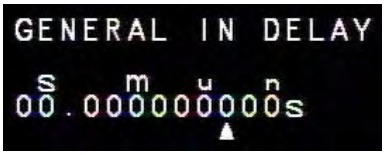
Set from the **SYNC IN/OUT** submenu, **SYNC IN DELAY**.

From the instant the synchronization signal is input, the camera will recognize the synchronization signal later than normal, after the specified amount of time set has elapsed. Increase or decrease the value with the **ARROW** ↑ ↓ keys, move the digit with the ←→ keys.

■**GENERAL IN DELAY** Setting Range: 0-60 (s), in 100 ns units

Set from the **SYNC IN/OUT** submenu, **GENERAL IN DELAY**.

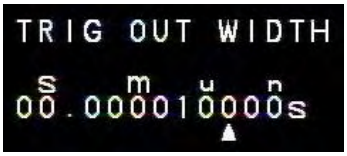
From the instant the GENERAL signal is input, the camera will recognize the GENERAL signal later than normal, after the specified amount of time set has elapsed. Increase or decrease the value with the **ARROW** ↑ ↓ keys, move the digit with the ←→ keys.



■**TRIG OUT WIDTH** Setting Range: 0-1 (ms), in 100 ns units

Set from the **SYNC IN/OUT** submenu, **TRIG OUT WIDTH**.

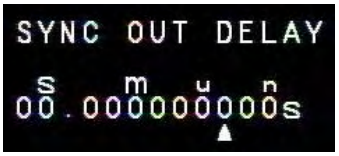
Set the output TTL signal's pulsewidth (length). Increase or decrease the value with the **ARROW** ↑ ↓ keys, move the digit with the ←→ keys.



■**SYNC OUT DELAY** Setting Range: 0-1/frame rate (s), in 100 ns units

Set from the **SYNC IN/OUT** submenu, **SYNC OUT DELAY**.

The synchronization signal will be output later than normal, delayed by the amount of time set here. Increase or decrease the value with the **ARROW** ↑ ↓ keys, move the digit with the ←→ keys.

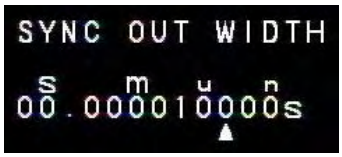


■**SYNC OUT WIDTH**

Setting Range: 0-500 (μs), 2000 fps or higher, 1/frame rate (s), in 100 ns units

Set from the **SYNC IN/OUT** submenu, **SYNC OUT WIDTH**.

Set the output synchronization signal's pulsewidth. Increase or decrease the value with the **ARROW** ↑ ↓ keys, move the digit with the ←→ keys.



■**EXPOSE OUT DELAY** Setting Range: 0-1/frame rate (s), in 100 ns units

Set from the **SYNC IN/OUT** submenu, **EXPOSE OUT DELAY**.

The exposure period signal will be output later than normal, delayed by the amount of time set here. Increase or decrease the value with the **ARROW** ↑ ↓ keys, move the digit with the ←→ keys.

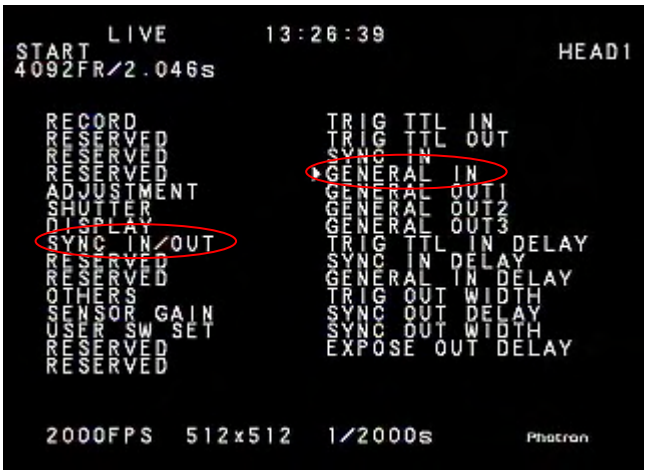
3.15. Event Marker Function

On the **FASTCAM MH4-10K**, it is possible to input an external signal during recording, at the instant the frame number is stored, and during playback the stored frame numbers (event markers) can be immediately accessed, or jumped to. This a separate feature from the trigger point, and by marking interesting points during recording, these points can be easily called up for review during playback. The event marker can store ten positions within a sequence.

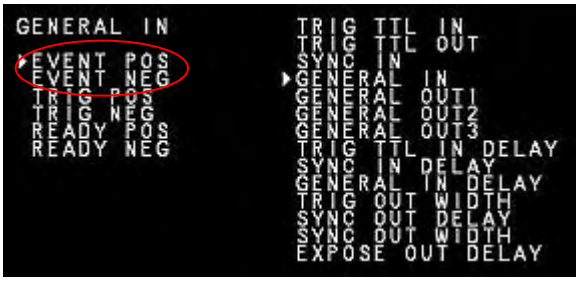
The frame number recording occurs on the pulse's edge, and the next frame after the pulse's edge is input is stored as the event marker.

1. Press the **MENU** key on the keypad and the menu list will display.

2. Select the **GENERAL IN** from the **SYNC IN/OUT** submenu with the **ARROW** keys on the keypad and press the **ENTER** key.



3. Select **EVENT POS** or **EVENT NEG** on the **GENERAL IN** menu. Select the polarity setting according to the signal to be used. The frame number is stored on the rising edge for **POS** and the falling edge for **NEG.**



4. During the recording operating, provide a pulse to the **GENERAL IN** connector.

5. A maximum of ten pulse inputs can be received.

6. Recording ends.

7. Put the camera in playback **MEMORY** mode.

8. Jump to the event frames with the **FRAME RATE** ▲▼ keys.

9. The screen text displays **EVENT FRAME X** when displaying an event frame. (Where X is a number from 1-10.)

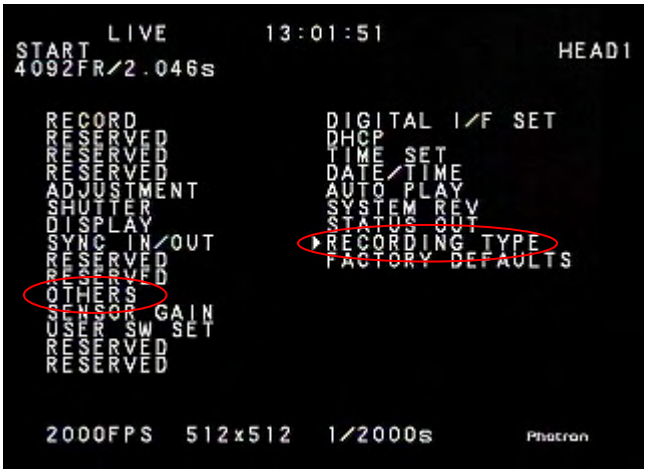
3.16. Direct Trigger Function

Normally for recording, the **READY** key is input and the camera is put in the **READY** state, then the trigger is input and the recording operation is performed. However, by setting the direct trigger mode, the recording operation can be performed without the **READY** key input.

Settings

1. Press the **MENU** key on the keypad and the menu list will display.

2. Select the **RECORDING TYPE** from the **OTHERS** submenu with the **ARROW** keys on the keypad and press the **ENTER** key.



3. Select either **READY AND TRIG** or **DIRECT TRIG**, displayed on the left side of the screen.

4. Press the **ENTER** key to confirm.

Camera Operations for Each Setting

◇READY AND TRIG

The **READY** input is always necessary before the **REC** trigger**.**

This is the camera's initial setting.

◇DIRECT TRIG

The recording operation can be performed with just the **REC** trigger, without the **READY** input**.**

Camera Operations for Each Trigger Mode in Direct Trigger

[ ] indicates the camera operations, "trigger" indicates the **REC** trigger input.

・START, RANDOM

[LIVE] → "trigger" → **[READY]** → "trigger" → **[REC]**

・CENTER, END, MANUAL

[LIVE] → "trigger" → **[ENDLESS]** → "trigger" → **[REC]**

3.17. Using USER SW (Programmable Switch)

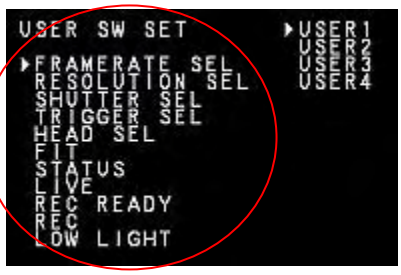
There are four switches that can be set on the front of the **FASTCAM MH4-10K** camera controller. Settings for the switches are made from the menu, and they can each be assigned a different function.

As an example, setting the **USER1** switch on the front of the camera controller is explained here.

1. Press the **MENU** key on the keypad and the menu list will display.

2. Select the **USER1** from the **USER SW SET** submenu with the **ARROW** keys on the keypad and press the **ENTER** key.

3. On the left side of the screen, the list of functions that can be set is displayed, select the function to be used and press the **ENTER** key. The available functions are explained in the chart below.



Setting Name	Explanation
FRAMERATE SEL	Can raise the frame rate.
RESOLUTION SEL	Can lower the resolution.
SHUTTER SEL	Can raise the shutter speed.
TRIGGER SEL	Can change the trigger mode.
HEAD SEL	Can change the head number displayed.
FIT	The same function as the keypad's FIT key.
STATUS	The same function as the keypad's STATUS key.
LIVE	The same function as the keypad's LIVE key.
REC READY	The same function as the keypad's REC READY key.
REC	The same function as the keypad's REC key.
LOW LIGHT	The same function as the keypad's LOW LIGHT key.

About the STATUS Key

The **STATUS** key is a display key that can be used to summarize and verify the status of the camera controller settings and the current status of the settings for each of the camera heads. Each press of the **STATUS** key will display the screens below in order.

1. Signal Settings

2. Camera Head 1 and 2 Settings

3. Camera Head 3 and 4 Settings

4. Shot Settings

5. Programmable Switch Settings

MEMO

Chapter 4. Playback

4.1. Video Playback

4.2. Fast-Forward and Rewind Playback

4.3. Single Frame Advance Playback

4.4. Enlarging and Shrinking the Playback Screen (Zoom, Fit, Scroll)

4.5. Segment of Interest Playback

4.6. Using the Playback Event Marker Function

4.1. Video Playback

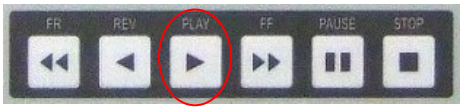
The **FASTCAM MH4-10K** can immediately playback images recorded to memory on a connected video monitor or on the keypad's LCD screen. This procedure is explained here.

1. Select the camera head to playback (Reference: "**2.4.7. Switching the Camera head to Set/Display**"). The camera head being displayed can be switched using this operation during playback.

2. Switch from **LIVE** to **MEMORY** mode. If the camera is in **LIVE** mode, press the keypad's **LIVE** key to switch to playback (memory) mode. The **LIVE** key LED will turn off.

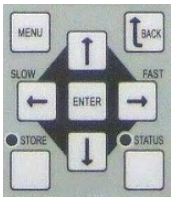
On the screen:

3. Press the **PLAY** key on the keypad to start playback of the recorded images.



Name	Function	Content
FR	Fast-Reverse	Fast-reverse playback of the recorded images at x10, x100, x1000 the current speed.
REV	Reverse Playback	Reverse playback of the recorded images at a speed of 2-30 frames/sec (NTSC), 2-25 frames/sec (PAL).
PLAY	Playback	Forward playback of the recorded images at a speed of 2-30 frames/sec (NTSC), 2-25 frames/sec (PAL).
FF	Fast-Forward	Fast-forward playback of the recorded images at x10, x100, x1000 the current speed.
PAUSE	Pause	Pause playback. The || mark will display in the upper portion of the video output screen. Frame advance can be performed by pressing the PLAY/REV key.
STOP	Stop	Stop playback and return to the trigger frame.

4. The playback speed can be changed with the **ARROW** ←→ keys on the keypad. The current playback speed is displayed in the upper part of the screen.



← slow fast →

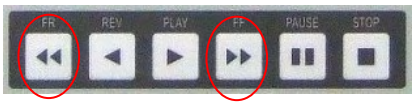
PAL Output Playback Rate	2, 4, 8, 12, 25 fps
NTSC Output Playback Rate	2, 5, 10, 15, 30 fps

4.2. Fast-Forward and Rewind Playback

Set the camera into **MEMORY** mode.

1. Press the **PLAY** key (Playback ▶).

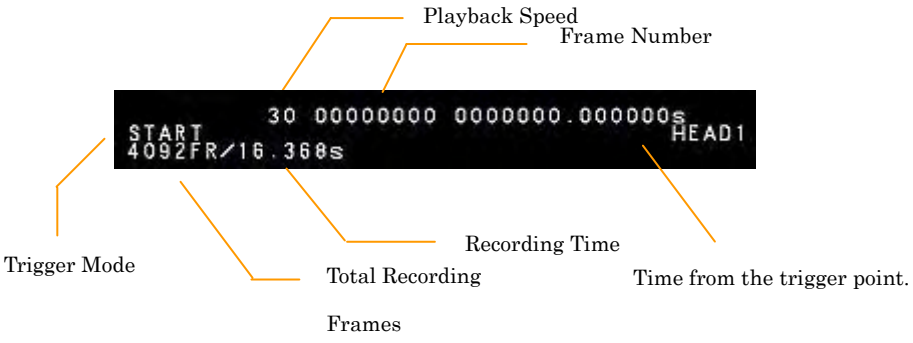
2. Press fast-forward, the **FF** key (▶ ▶), and rewind, the **FR** key (◀ ◀), to search for the desired scene.



3. Each time fast-forward, the **FF** key (▶ ▶), or rewind, the **FR** key (◀ ◀), is pressed; it can change the normal playback speed in three steps, by x10, x100, or x1000.

4. Press the **PLAY** key (▶) to return to normal speed playback, or press the **PAUSE** key (II) to pause playback.

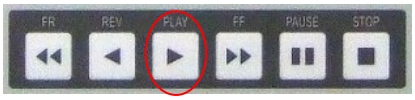
5. As an example, the display on the screen will be similar to the image shown below.



4.3. Single Frame Advance Playback

Set the camera into **MEMORY** mode.

1. Press the **PLAY** key (▶).



2. Press fast-forward, the **FF** key (▶ ▶), and rewind, the **FR** key (◀ ◀), to search for the desired scene.

3. When the desired scene is found, press the **PAUSE** key (II) and playback will be paused.

4. Verify that the (II) mark is displayed on the screen.

5. By pressing playback, the **PLAY** key (▶), or reverse playback, the **REV** key (◀), the frame is advanced or reversed one frame at a time. By pressing fast-forward, the **FF** key (▶ ▶), or rewind, the **FR** key (◀ ◀), the frame is advanced in ten frames at a time.

4.4. Enlarging and Shrinking the Playback Screen (Zoom, Fit, Scroll)

On the **FASTCAM MH4-10K**, recording is done with a sensor that has a maximum resolution of 512x512 pixels. When displaying the images on an NTSC monitor, the resolution of the image is larger vertically than the monitor resolution (640 x 480 pixels), therefore a slight portion of the top and bottom of the image will not be displayed on the monitor in the normal 1:1 display mode. Also, when the vertical resolution of the image is lowered, to 512 x 256 for example, the image will be smaller than the video monitor's resolution in a 1:1 display mode.

In these cases, by using the fit function, the image will be instantly enlarged or shrunk to the appropriate resolution to fill the screen

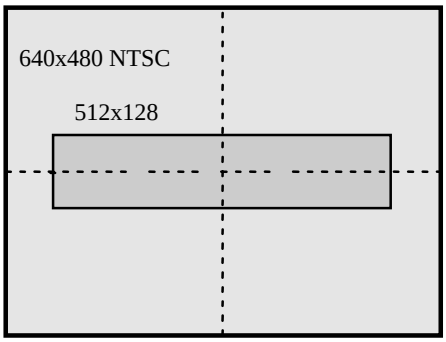
Additionally, by using the zoom function, the image can be enlarged or shrunk by the set zoom factor, making it possible to verify details, or look over the entire scene.

The video output digital zoom functions and how to use them are explained here.

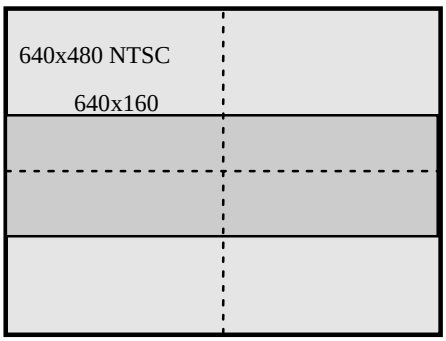
4.4.1. Video Screen Fit Display

For video output on the **FASTCAM MH4-10K**, the size of the image at different resolutions is adjusted so that it is displayed at its maximum size on the screen. The following example explains an example where a 512x128 pixel screen is being fit to the video screen.

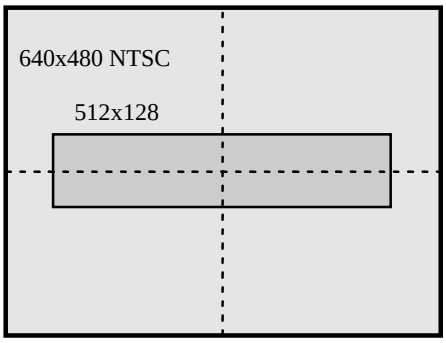
1. Press the **FIT/1:1** key on the keypad.



2. The video screen's display size changes, and the recording area is displayed at its maximum size on the screen.



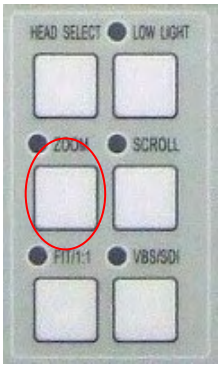
3. Press the **FIT/1:1** key again to return to the original size.



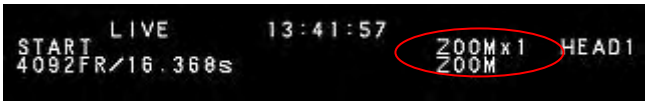
4.4.2. Displaying the Video Screen Enlarged (Zoom)

For video output on the **FASTCAM MH4-10K**, the image can be displayed zoomed (enlarged).

1. Press the **ZOOM/SCROLL** key on the keypad.



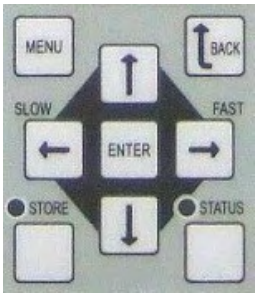
2. The **ZOOM** key LED on the keypad will light. The **ZOOM** message and the current zoom factor will also be displayed in the upper right of the video output screen.



3. With the **ARROW** ↑ ↓ keys, enlarge or shrink. The center of the image displayed on the screen is maintained while the image is enlarged or reduced.

↑
zoom in

zoom out
↓



4.4.3. Scrolling the Video Screen

For video output on the **FASTCAM MH4-10K**, the image can be displayed zoomed (enlarged).

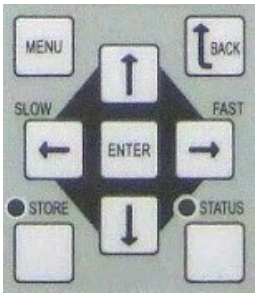
1. Press the **ZOOM/SCROLL** key on the keypad. This button is shared with the zoom function, so verify that the **SCROLL** key LED on the keypad is illuminated.

2. The SCROLL message is displayed in the upper right of the video output screen.

3. Scroll the screen with the **ARROW** keys. When the shot area is already fully displayed in the video screen, scroll cannot be used.

↑
up

down
↓



←left right→

4.5. Segment of Interest Playback

The playback of images shot at high-speed takes an extraordinary amount of time. For example, when played back at a normal 30 fps, one second of video shot at high-speed at 2000 frames a second takes 66 seconds to playback, in other words, over a minute of playback time. In many cases, the desired range of images is only a few images out the recorded 2000. On the **FASTCAM MH4-10K**, the start and stop points of the desired range of images can be specified, and the **segment playback** function is available to playback only that range of images.

The procedure for using **segment playback** is explained here.

1. Put the camera in **MEMORY** playback mode.

2. Playback with the normal procedure.

3. Press the **START** key at the start point of the desired range of images.

4. Press the **END** key at the stop point of the desired range of images.

5. Press **ON/OFF** key in the **SEGMENT PLAY BACK** section of the keypad, and verify that the LED is lit. This puts the system in **segment playback** mode.

6. All of the normal playback operations described above will now occur only within the range specified by the start and stop points.

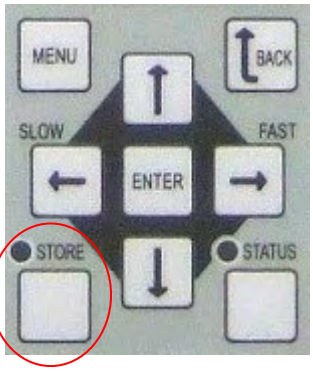
4.6. Using the Playback Event Marker Function

During MEMORY mode, 10 playback image frame numbers can be stored, and those stored frame numbers (event marker frame) can be immediately accessed, or jumped to. By marking the desired position while the image is played back, this convenient function can easily recall those positions.

1. Put the camera in **MEMORY** playback mode.

2. Playback with the normal procedure.

3. When the desired frame is displayed, press the **STORE** key to save it.



4. Repeat steps 2 and 3 above, a total of 10 points can be stored.

5. The marker frames can be jumped to with the **SHUTTER** ▲▼ keys.

6. When a marker frame is displayed, the "**MARKER FRAME X**" text will appear on the screen. (Where X is a number between 1 and 10)

When storing frames and going over 10 points,

The frame numbers will be overwritten in order from the first stored.

Chapter 5. Connecting a PC

5.1. Connecting a PC to the Camera Controller's Gigabit Ether Interface

5.1. Connecting a PC to the Camera Controller's Gigabit Ether Interface

Connecting the **FASTCAM MH4-10K** and a **PC** (a personal computer) is explained here.

On the **FASTCAM MH4-10K**, the operation of the camera functions can be controlled from a PC using the Gigabit Ether interface. Refer to the "**PHOTRON FASTCAM Viewer User's Manual**" for how to operate the software camera controller.

This section explains the necessary preparation when connecting the system to a **PC**.

To connect a PC to the **FASTCAM MH4-10K**, connect the camera controller with a LAN cable to a commercial available 1000BASE-T capable interface board on the PC. For the LAN cable, prepare a UTP or STP Cat 5e (enhanced category 5) or higher LAN cable.

The maximum cable length between the PC and the **FASTCAM MH4-10K** is, compliant to the 1000BASE-T specification, up to 100 m. One PC can connect to a maximum of 64 camera controllers using a hub. Use a switching hub that can connect at 1000BASE-T. The maximum length of the cable that connects the camera controller (or PC) to the switching hub is also 100 m.

The necessary settings to make after the **FASTCAM MH4-10K** and the PC are connected with a LAN cable are listed below.

■ **Camera**

- IP Address Setting.

Refer to "**5.1.2. Setting the Camera's IP Address**".

■ **PC**

- IP Address Setting
- Packet Size
- Time Out Length
- Communications Port

Refer to the "**PHOTRON FASTCAM Viewer User's Manual**".

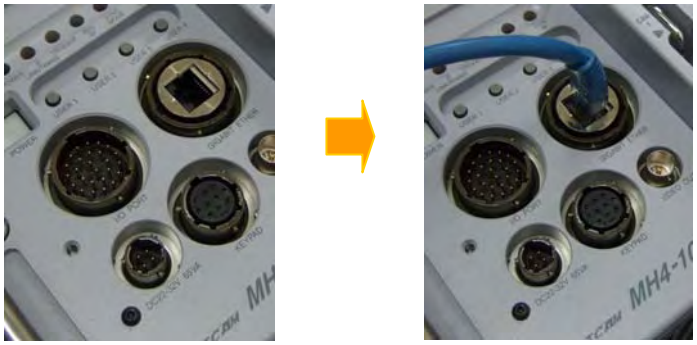
The FASTCAM MH4-10K is 1000BASE-T capable. When using a PC capable of only 10BASE-T or 100BASE-TX, the PC must be connected through a switching hub capable of 10BASE-T, 100BASE-TX, and 1000BASE-T.

The camera's factory default IP address is below:

IP ADDRESS:	192.168.0.10
NETMASK:	255.255.255.0
GATEWAY ADDRESS:	0.0.0.0
PORT:	2000 (Fixed, not changeable)

5.1.1. Connecting the FASTCAM MH4-10K and a PC

Connect the LAN cable to the **FASTCAM MH4-10K** as shown below.



Push the LAN cable

into the connector.

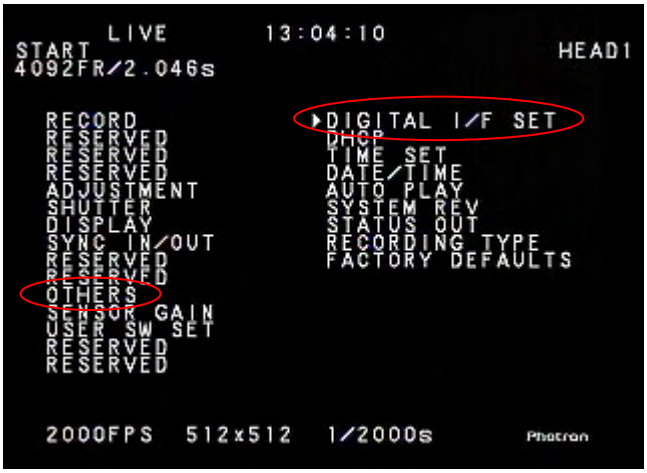
5.1.2. Setting the Camera Controller's IP Address

The procedure for setting the camera controller's IP address is shown below.

Setting Procedure

1. Press the **MENU** key on the keypad and the menu list will display.

2. Select the **DIGITAL I/F SET** from the **OTHERS** submenu with the **ARROW** keys on the keypad and press the **ENTER** key.



3. Use the **ARROW** ←→ keys to move the digit and the ↑ ↓ keys to set the IP address.

4. Press the **ENTER** key to confirm.

It is possible to connect a PC to multiple camera controllers by setting the camera controllers to different IP addresses. Do not use an IP address that is already in use on a network.

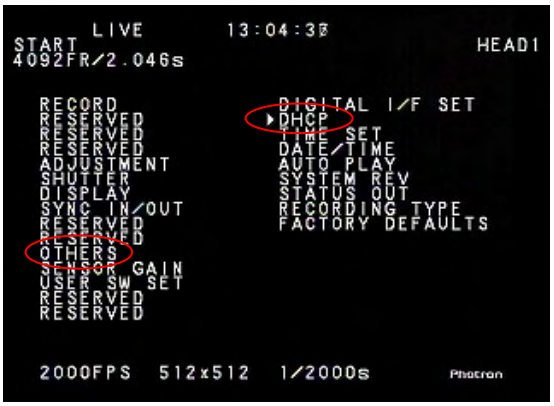
5.1.3. Using DHCP (Dynamic Host Configuration Protocol)

The camera is DHCP capable. In an environment where DHCP is used, the camera's IP address can be acquired from the DHCP server.

Setting Procedure

1. Press the **MENU** key on the keypad and the menu list will display

2. Select the **DHCP** from the **OTHERS** submenu with the **ARROW** keys on the keypad and press the **ENTER** key.



3. Use the **ARROW** ↑ ↓ keys to select ON or OFF.

4. Press the **ENTER** key to confirm.

- When OFF is selected, the IP address specified in the previous section "**5.1.2. Setting the Camera Controller's IP Address**" is valid.
- When ON is selected, the IP address is acquired from the DHCP server, and the acquired IP address is valid. If the system is not connected to the DHCP server, the IP address is acquired when a connection to the server is made. It is possible to verify the acquired IP address with the **DIGITAL I/F SET** menu. In this case, the IP address cannot be changed.

When using the system with DHCP on, set the IP address on the PFV to "Auto detection". For details, refer to the "PHOTRON FASTCAM Viewer User's Manual".

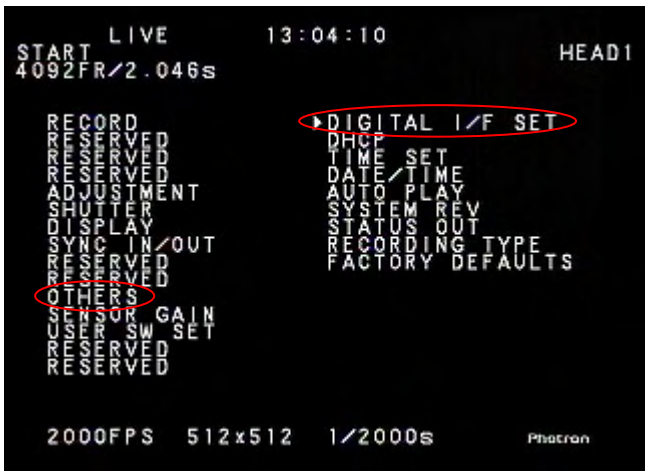
5.1.4. Connecting the PC to Multiple Cameras

With **PFV**, the **FASTCAM MH4-10K** control software, one **PC** can connect to and control, multiple **FASTCAM MH4-10K** and **FASTCAM-ultima APX-RS (Gigabit Ether)** systems.

When connecting to multiple systems, set the IP address of each camera to a unique setting.

1. Press the **MENU** key on the keypad and the menu list will display.

2. Select the **DIGITAL I/F SET** from the **OTHERS** submenu with the **ARROW** keys on the keypad.



3. The IP address menu is displayed.

4. Assign each camera a unique IP address setting with the **ARROW** keys and press the **ENTER** key.

5. Press the **MENU** key to close the menu list, the settings are stored.

6. The settings are reflected when the **PC** is connected.

Chapter 6. System Settings

6.1. Display Settings

6.2. Other Detailed Settings

6.1. Display Settings

In addition the image, the **FASTCAM MH4-10K** can display many types of information necessary for recording on the video monitor. The procedure for setting the display of this information on the video monitor is explained here.

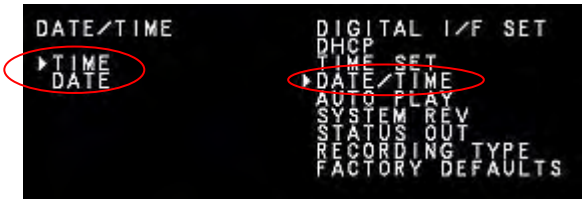
6.1.1. Changing the Date/Time Display

Either the date or the time can be selected and displayed on the screen. The procedure for the displaying this is explained here.

1. Press the **MENU** key on the keypad and the menu list will display.

2. Select **DATE/TIME** from the **OTHERS** submenu with the **ARROW** keys on the keypad and press the **ENTER** key.

3. The **DATE/TIME** menu is displayed.



4. Select **DATE/TIME** with the **ARROW** ↑ ↓ keys. The selected option is displayed on the screen.

5. When finished, press the **ENTER** key to complete the setting.

6. Verify that the date or the time is displayed according to the option set.

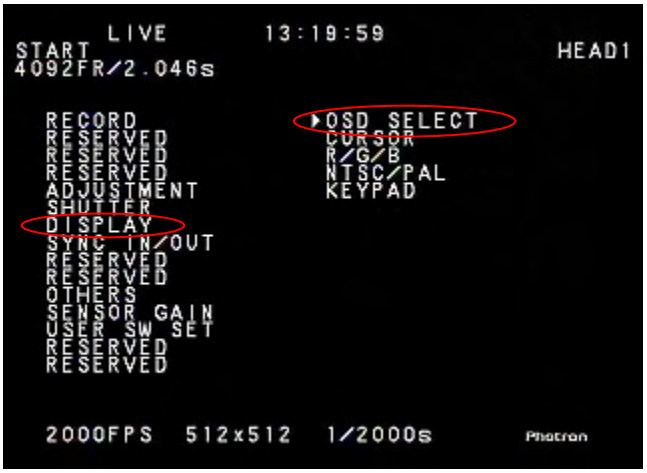
Date Display Setting

Time Display Setting

6.1.2. Display/Hide On Screen Display (OSD) Text

1. Press the **MENU** key on the keypad and the menu list will display.

2. Select **OSD SELECT** from the **DISPLAY** submenu with the **ARROW** keys and press the **ENTER** key.



3. Select **ON/OFF** with the **ARROW** keys. When **ON**, text on the screen is displayed. When **OFF**, text on the screen is not displayed.

4. When finished, press the **ENTER** key to store the setting.

5. Verify that the screen's text display is **ON** or **OFF**.

6.1.3. Display Cross Hairs

Display cross hairs (a reference line, or reticule) on the video monitor. They can be used to determine the position of an object within the image or as an aid when viewing the playback.

1. Press the **MENU** key on the keypad and the menu list will display.

2. Select **CURSOR** from the **DISPLAY** submenu with the **ARROW** keys on the keypad and press the **ENTER** key.

3. Select either **OFF**, **ON1**, or **ON2** with the ↑ ↓ keys on the keypad, and press the **ENTER** key. Two types of cursor are provided, a white line (ON1) or a black line (ON2).

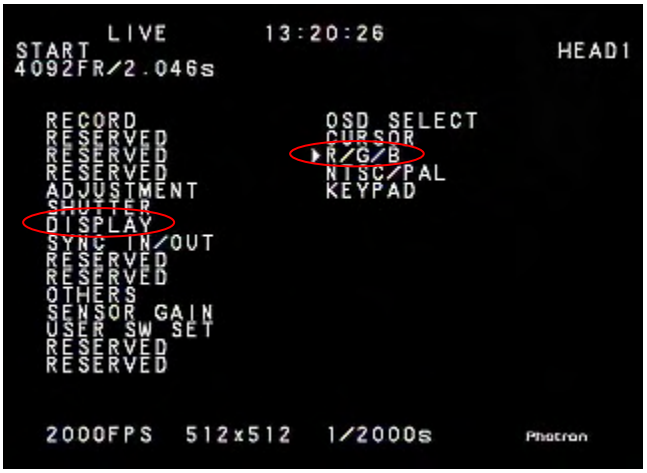
4. When ON 1 or 2 are selected, a reference line cross (reticule) is displayed on the screen. At the same time, the coordinate value for the center point of the cross is displayed on the screen.

5. The reference line can be moved to any position using the **ARROW** keys.

6.1.4. Display R/G/B Plane (Color Models Only)

1. Press the **MENU** key on the keypad and the menu list will display.

2. Select **R/G/B** from the **DISPLAY** submenu with the keypad **ARROW** keys and press the **ENTER** key.



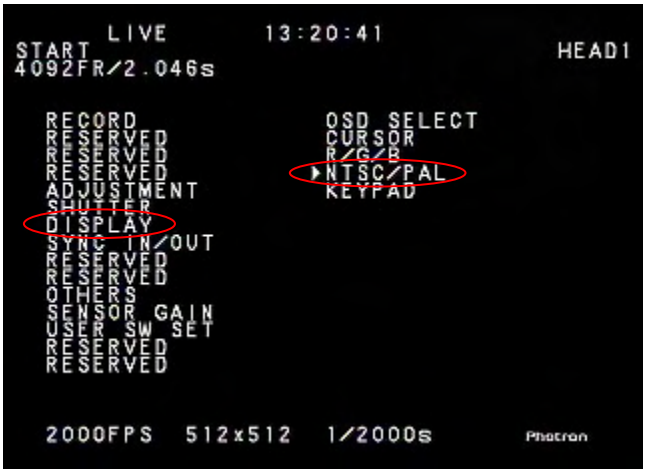
3. Select the **R/G/B** element to be displayed, or to display all of the **RGB** elements with the keypad ↑ ↓ keys. Press the **ENTER** key, to complete the setting.

6.1.5. Select the Video Signal Standard (NTSC or PAL)

Select the **FASTCAM MH4-10K's** video output signal standard. The standard can be selected from **NTSC or PAL**.

1. Press the **MENU** key on the keypad and the menu list will display.

2. Select **NTSC/PAL** from the **DISPLAY** submenu with the keypad **ARROW** keys and press the **ENTER** key.



3. Select the **NTSC** or **PAL** with the keypad ↑ ↓ keys, and press the **ENTER** key.

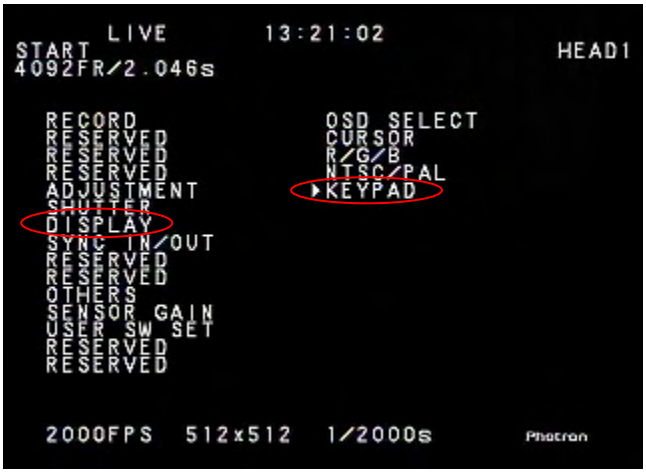
4. The video output format is changed.

6.1.6. Keypad LCD Settings

There are three settings for the keypads LCD display, BRIGHT (brightness), CONTRAST (contrast), and COLOR (tint).

1. Press the **MENU** key on the keypad and the menu list will display.

2. Select **KEYPAD** from the **DISPLAY** submenu with the keypad **ARROW** keys and press the **ENTER** key**.**



3. Select **BRIGHT**, **CONTRAST**, or **COLOR** with the keypad ↑ ↓ keys and press the **ENTER** key.

■ **BRIGHT** Setting

Change the LCD's brightness with the keypad ↑ ↓ keys.

The ↑ key brightens, the ↓ key darkens.

■ **CONTRAST** Setting

Change the LCD's contrast with the keypad ↑ ↓ keys.

The ↑ key increases the contrast, the ↓ key decreases the contrast.

■ **COLOR** Setting

Change the LCD's tint with the keypad ↑ ↓ keys.

6.2. Other Detailed Settings

6.2.1. Setting the Date/Time

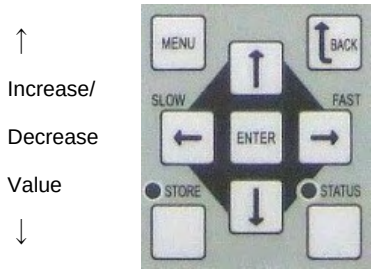
Set the **FASTCAM MH4-10K's** internal clock. Set the date or time, it can be displayed within the recorded image. Once the date/time is set, the entered values are saved even when the system power is turned off.

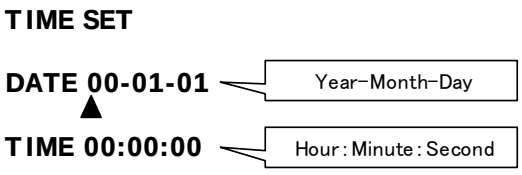
1. Press the **MENU** key on the keypad and the menu list will display.

2. Select **TIME SET** from the **OTHERS** submenu with the keypad **ARROW** keys and press the **ENTER** key.

3. The **TIME SET** setting items are displayed on the left of the screen.

4. The ←→ **ARROW** keys move to the item, the ↑ ↓ keys can change the setting value.





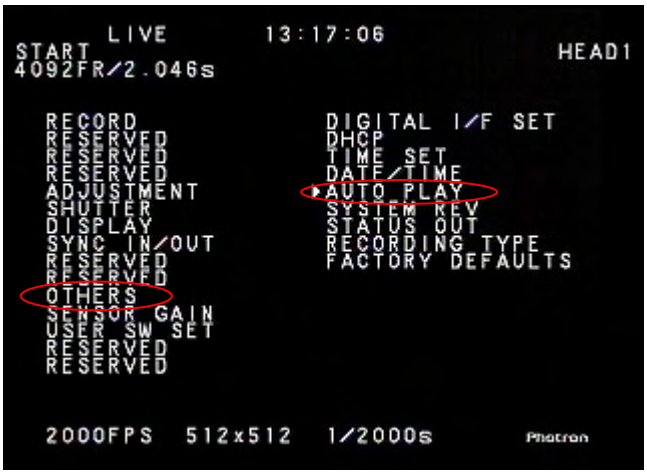
5. When finished entering the settings, press the **ENTER** key to complete.

6.2.2. Post-Recording Auto-Playback Setting (AUTO PLAY)

The **FASTCAM MH4-10K** is equipped with a mode that automatically switches the system from **LIVE** mode to **MEMORY** (playback) mode, displays the trigger frame and pauses the playback immediately the recording is finished. This mode can be used by setting **AUTO PLAY** to **ON**. This function is convenient for immediately verifying the recorded video after recording.

1. Press the **MENU** key on the keypad and the menu list will display.

2. Select **AUTO PLAY** from the **OTHERS** submenu with the keypad **ARROW** keys.



3. The menu to select **AUTO PLAY ON/OFF** displays on the left side of the screen.

4. Select **ON/OFF** with the keypad ↑ ↓ keys. Press the **ENTER** key, then the **MENU** key to close the menu list, the setting is complete.

5. Perform a recording operation, and verify that the system automatically replay after recording.

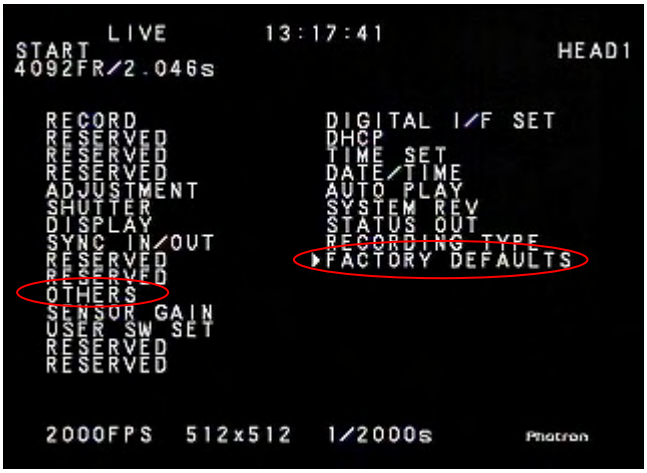
6.2.3. Reset to Factory Default State

The settings (frame rate, resolution, menu settings, etc.) on the **FASTCAM MH4-10K** can be reset to the factory default state.

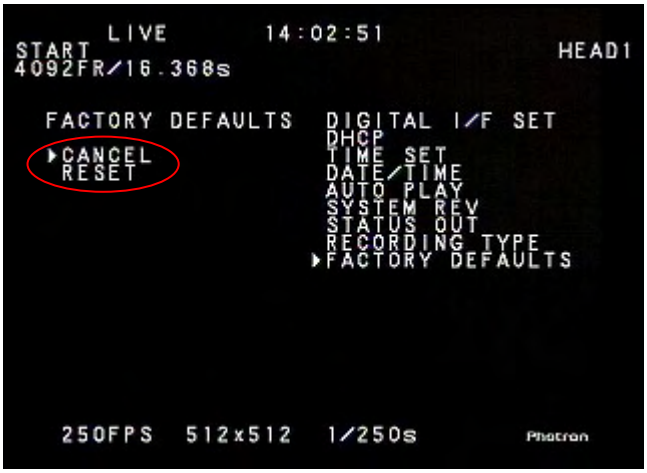
Setting Procedure

1. Press the **MENU** key on the keypad and the menu list will display.

2. Move to the **FACTORY DEFAULTS** item from the **OTHERS** submenu with the keypad **ARROW** keys and press the **ENTER** key.



3. Select **CANCEL** or **RESET** with the keypad ↑ ↓ keys. **CANCEL** cancels the reset operation. **RESET** executes the system reset.



4. Press the **ENTER** key to confirm.

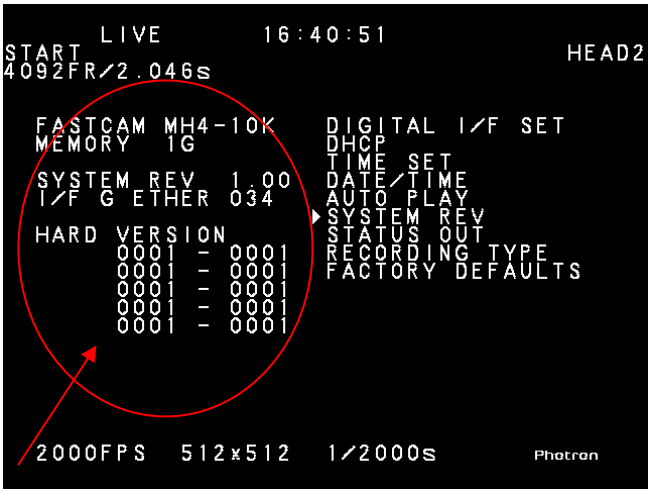
6.2.4. Display the System Revision

Displays the system version number for the **FASTCAM MH4-10K**.

1. Press the **MENU** key on the keypad and the menu list will display.

2. Select **SYSTEM REV** from the **OTHERS** submenu with the keypad **ARROW** keys and press the **ENTER** key.

4. The system version of the camera currently being used is displayed.



Camera name, memory amount, system revision, I/F version, hardware version are displayed.

MEMO

Chapter 7. Product Specifications

7.1. Specifications

7.2. Measurements

7.1. Specifications

7.1.1. Product Specifications

Image Sensor	CMOS image sensor	
Sensor Resolution	512 x 512 pixels	
Frame Rate	2,000 fps full frame	
Lens Mount	NF mount, (C mount with optional adapter)	
Recording Color Depth	Monochrome	8-bit
	Color	RGB, each 8-bit (Bayer color filter method)
Shutter	Electronic shutter	
Recording Method	IC memory	
Recording Memory Amount	1 GB standard, 2 GB maximum (per camera head)	
Trigger Method	START, CENTER, END, MANUAL, RANDOM	
Gain Control	Hardware LUT on camera, controllable via keypad or software	
Image Output Customization	Customizable LUT, brightness is changeable	
External Synchronization Input Signal	5Vp-p, negative polarity/positive polarity (switch able)	
External Synchronization Output Signal	5Vp-p, negative polarity/positive polarity (switch able)	
Trigger Input Signal	TTL, contact	
Other Output Signals	Other timing signal outputs, event marker input	
External Control	Keypad, RS-422 external control I/F, digital IF (PC)	
Video Output Signal	RS170 (NTSC/PAL), digital zoom function, scroll, fit function included	
Digital Interface	Gigabit Ether (1000BASE-T)	

7.1.2. General Specifications

Environment Conditions	
Storage Temperature	-20ºC ~ 60ºC (no condensation) -4ºF ~ 140ºF (no condensation)
Storage Humidity	85% or less (no condensation)
Operating Temperature	0ºC ~ 40ºC (no condensation) 32ºF ~ 104ºF (no condensation)
Performance Humidity	85% or less (no condensation)
Shock Resistance Performance	100 G 10 ms 6 axis (Guaranteed only when the lens is used a reinforced NF mount lens)
External Dimensions	
Camera Controller	245 (W) x 160 (H) x 150 (D) mm 9.65” (W) x 6.3” (H) x 5.9” (D)
Camera head	35 (W) x 35 (H) x 34 (D) mm 1.38” (W) x 1.38” (H) x 1.34” (D)
AC Adapter	95 (W) x 63.5 (H) x 178 (D) mm, excluding protruding 5.51” (W) x 2.5” (H) x 7” (D)
Keypad	140 (W) x 105 (H) x 20.8 (D) mm, excluding protruding 5.51” (W) x 4.13” (H) x 0.82” (D)
AC Power	
Supply Voltage	Japanese Spec. 100V, US Spec. 120V, EU Spec. 240V,
Supply Frequency	50 Hz - 60 Hz
Power Consumption	68 VA
DC Power	
Supply Voltage	22 V - 32 V
Power Consumption	65 VA
Weight	
Camera Controller	7.6 kg. 16.8 lb.
Camera head	90 g. 3.17 Oz.
AC Adapter	670 g. 23.63 Oz.
Keypad	1310 g. 46.2 Oz

Photron has verified two types of AC cables, the type A (standard for Japan, USA, Canada, etc.) and the type SE (standard for Germany, France, etc.). However, when those cables cannot properly receive power when plugged in, user the proper AC cable for the region’s standards, and verify that AC cable works properly.

For inquires regarding the recommended AC cable for a region, contact that region’s Photron branch office or the Photron-authorized distributor.

7.1.3. Options

User Options
High-G Housings (Lens, Camera head Screw Reinforcement Housings)
Tripod Adapter
Mounting Brackets (For the camera controller, normal and high-g camera heads)
High-G Battery
High-G Camera Cable
Cable Anchor Handle
LCD Monitor Keypad
NF Mount Lenses. (f=3.5mm, f=6mm, f=12mm)
C Mount Adapter
DC Connector for External Power Supply
Dedicated Carrying Case

7.1.4. Frame Rate and Resolution

Maximum Resolution	Frame Rate (fps)	Settable Resolution				
		512 x 512	512 x 352	512 x 256	512 x 128	512 x 96
512 x 512	50 (PAL)	Yes	Yes	Yes	Yes	Yes
	60	Yes	Yes	Yes	Yes	Yes
	125	Yes	Yes	Yes	Yes	Yes
	250	Yes	Yes	Yes	Yes	Yes
	500	Yes	Yes	Yes	Yes	Yes
	1000	Yes	Yes	Yes	Yes	Yes
	2000	Yes	Yes	Yes	Yes	Yes
512 x 352	3000	No	Yes	Yes	Yes	Yes
512 x 256	4000	No	No	Yes	Yes	Yes
512 x 128	5000	No	No	No	Yes	Yes
	6000	No	No	No	Yes	Yes
	7000	No	No	No	Yes	Yes
	8000	No	No	No	Yes	Yes
512 x 96	9000	No	No	No	No	Yes
	10000	No	No	No	No	Yes

7.1.5. Recordable Image Count/Resolution

Resolution	Recordable image count with 1 GB of memory	Recordable image count with 2 GB of memory
512 x 512	4092	8188
512 x 352	5952	11909
512 x 256	8184	16376
512 x 128	16368	32752
512 x 96	21824	43669

Recording Time = Recordable Image Count divided by frame rate (fps)

7.1.6. Shutter Speed List

1/frame					
1/125	1/250	1/500	1/700	1/1000	1/1250
1/1600	1/2000	1/2500	1/2800	1/4000	1/5000
1/5600	1/6400	1/8000	1/10000	1/14000	1/16000
1/20000	1/28000	1/40000	1/56000	1/70000	1/80000
1/112000	1/140000	1/160000			

7.1.7. RS-422 Serial Controller Commands

About the RS-422 Communications Protocol and Commands

The RS-422 Communications Protocol

The processor is a UART-type asynchronous system, and it uses the NRZ (non-return-to-zero) format (8 data bits, 2 stop bits, no parity). The baud rate is 4800 baud.

Camera Setting Commands

The various camera settings are performed with the camera setting commands. The commands are equivalent to the keypad key operations.

Camera Setting Commands			
FRAME RATE ↑	0x60	BACK	0x7D
FRAME RATE ↓	0x61	SCROLL	0x7E
RESOLUTION ↑	0x62	STATUS	0x40
RESOLUTION ↓	0x63	PRESET1	0x41
SHUTTER ↑	0x64	PRESET2	0x42
SHUTTER ↓	0x65	PRESET3	0x43
TRIGGER ↑	0x66	PRESET4	0x44
TRIGGER ↓	0x67	HEAD SELECT	0x45
LIVE/MEMO	0x68	LOW LIGHT	0x46
FR <<	0x69		
REV <	0x6A		
PLAY >	0x6B		
FF >>	0x6C		
PAUSE ‖	0x6D		
STOP	0x6E		
BLOCK S	0x6F		
BLOCK E	0x70		
BLOCK ON/OFF	0x71		
REC READY	0x72		
REC	0x73		
STORE	0x74		
MENU ON/OFF	0x75		
ENTER	0x76		
ZOOM	0x77		
FIT	0x78		
UP ↑	0x79		
DOWN ↓	0x7A		
LEFT ←	0x7B		
RIGHT →	0x7C		

Request to Acquire Camera Data Commands

Camera setting data can be acquired. The camera data with a support command can be acquired.

Request to Aquire Camera Data Commands		
FRAME RATE	0xA0	0xA2
RESOLUTION	0xA0	0xA3
SHUTTER	0xA0	0xA4
TRIGGER	0xA0	0xA5
LIVE/MEMO	0xA0	0xA6
HEAD SELECT	0xA0	0xA7
TOTAL FRAME	0xA0	0xAB
RANDOM FRAME	0xA0	0xAC
MANUAL TRIGGRE	0xA0	0xAD
COLOR TEMP	0xA0	0xB1
LUT SELECT	0xA0	0xB2
EDGE ENHANCE	0xA0	0xB3
SHUTTER MODE	0xA0	0xB6
OSD SELECT	0xA0	0xB7
R/G/B	0xA0	0xB8
NTSC/PAL	0xA0	0xB9
TRIG TTL IN	0xA0	0xBA
TRIG TTL OUT	0xA0	0xBB
SYNC IN	0xA0	0xBC
GENERAL IN	0xA0	0xBD
GENERAL OUT1	0xA0	0xBE
GENERAL OUT2	0xA0	0xBF
GENERAL OUT3	0xA0	0xC0
TRIG TTL IN DELAY	0xA0	0xC1
SYNC IN DELAY	0xA0	0xC2
GENERAL IN DELAY	0xA0	0xC3
TRIG OUT WIDTH	0xA0	0xC4
SYNC OUT DELAY	0xA0	0xC5
SYNC OUT WITDH	0xA0	0xC6
EXPOSE OUT DELAY	0xA0	0xC7
IP ADDRESS	0xA0	0xCA
NET MASK ADDRESS	0xA0	0xCB
GATEWAY ADDRRSS	0xA0	0xCC
DHCP	0xA0	0xCD
DATE/TIME	0xA0	0xCE
AUTO PLAY	0xA0	0xCF
SYSTEM REV	0xA0	0xD0
STATUS OUT	0xA0	0xD1
RECORDING TYPE	0xA0	0xD2
SENSOR GAIN	0xA0	0xD3
COLOR ENHANCEMENT	0xA0	0xD4

Camera Information Reply Commands

Returns the camera data requested with the request to acquire camera data command. At this time, following the camera data reply command which indicates the type of camera data, the setting return command, which indicates the setting contents, is returned. The setting return command holds a numerical meaning, and 8-byte or 16-byte portions (only when the data bit portion is converted) are continuously returned.

* The continuous transmission of 16-byte data portions only occurs when returning the resolution information setting.

Example: A request for the frame rate data when the camera has a frame rate of 2000 fps.

1. Send the request to acquire camera data command “0xA0” to the camera.
2. The camera returns the data reply command “0xD0”.
3. Next, the setting reply command “0x30”, “0x30”, “0x30”, “0x30”, “0x32”, “0x30”, “0x30”, “0x30” is continuously returned.

Camera Data Reply Commands			Setting Reply Command (8 or 16 bytes)
FRAME RATE	0xA1	0xA2	00000050 – 00010000
RESOLUTION	0xA1	0xA3	00000512 00000096 – 00000512 00000512
SHUTTER	0xA1	0xA4	00000050 – 00160000
TRIGGER	0xA1	0xA5	00000000: START 00000001: CENTER 00000002: END 00000003: MANUAL 00000004: RANDOM
LIVE/MEMO	0xA1	0xA6	00000000: LIVE 00000001: MEMO
HEAD SELECT	0xA1	0xA7	00000001 – 00000004
TOTAL FRAME	0xA1	0xAB	00000001 – 0xxxxxxx
RANDOM FRAME	0xA1	0xAC	00000001 – 0xxxxxxx
MANUAL TRIGGER	0xA1	0xAD	00000001 – 0xxxxxxx

COLOR TEMP	0xA1	0xB1	00000001: 5100K 00000002: 3100K 00000003: USER1
LUT SELECT	0xA1	0XB2	00000001: D1 00000002: D2 00000003: D3 00000004: D4 00000005: D5 00000006: D6 00000007: USER
EDGE ENHANCEMENT	0xA1	0xB3	00000001: OFF 00000002: MODE1 00000003: MODE2 00000004: MODE3
SHUTTER MODE	0xA1	0xB6	00000001: MODE1 00000002: MODE2
OSD SELECT	0xA1	0xB7	00000001: ON 00000002: OFF
NTSC/PAL	0xA1	0xB8	00000001: NTSC 00000002: PAL
R/G/B	0xA1	0xB9	00000001: ALL 00000002: R 00000003: G 00000004: B
TRIG TTL IN	0xA1	0xBA	00000001: TRIG TTL IN POS 00000002: TRIG TTL IN NEG
TRIG TTL OUT	0xA1	0xBB	00000001: TIRG POS 00000002: TRIG NEG 00000003: TTL IN THRU POS 00000004: TTL IN THRU NEG
SYNC IN	0xA1	0xBC	00000001: OFF 00000002: ON CAM POS 00000003: ON CAM NEG 00000004: ON OHTERS POS 00000005: ON OHTERS NEG
GENERAL IN	0xA1	0xBD	00000001: SYNC POS 00000002: SYNC NEG 00000003: TRIG POS 00000004: TRIG NEG 00000005: READY POS 00000006: READY NEG

GENERAL OUT1 GENERAL OUT2 GENERAL OUT3	0xA1 0xA1 0xA1	0xBE 0xBF 0xC0	00000001: EVENT POS 00000002: EVENT NEG 00000003: EXPOSE HEAD1 POS 00000004: EXPOSE HEAD1 NEG 00000005: EXPOSE HEAD2 POS 00000006: EXPOSE HEAD2 NEG 00000007: EXPOSE HEAD3 POS 00000008: EXPOSE HEAD3 NEG 00000009: EXPOSE HEAD4 POS 00000010: EXPOSE HEAD4 NEG 00000011: REC POS 00000012: REC NEG 00000013: TRIG POS 00000014: TRIG NEG 00000015: READY POS 00000016: READY NEG
TRIG TTL IN DELAY	0xA1	0xC1	00000000 00000000 – 00000006 00000000
SYNC IN DELAY	0xA1	0xC2	00000000 00000000 – 00000006 00000000
GENERAL IN DELAY	0xA1	0xC3	00000000 00000000 – 00000006 00000000
TRIGGER OUT WIDTH	0xA1	0xC4	00000000 00000000 – 00000006 00000000
SYNC OUT DELAY	0xA1	0xC5	00000000 00000000 – 00000006 00000000
SYNC OUT WIDTH	0xA1	0xC6	00000000 00000000 – 00000006 00000000
EXPOSE OUT DELAY	0xA1	0xC7	00000000 00000000 – 00000006 00000000
IP ADDRESS	0xA1	0xCA	01920168 0XXX0YYY
NET MASK ADDRESS	0xA1	0xCB	01920168 0XXX0YYY
GATEWAY ADDRESS	0xA1	0xCC	01920168 0XXX0YYY
DHCP	0xA1	0xCD	00000001: OFF 00000002: ON

DATE/TIME	0xA1	0xCE	00000001: DATE 00000002: TIME
AUTO PLAY	0xA1	0xCF	00000001: OFF 00000002: ON
SYSTEM REV	0xA1	0xD0	00000123
STATUS OUT	0xA1	0xD1	00000001: ON 00000002: OFF
RECORDING TYPE	0xA1	0xD2	00000001: READY AND TRIG 00000002: DIRECT TRIG
SENSOR GAIN	0xA1	0xD3	00000001: x1 00000002: x2
COLOR ENHANCEMENT	0xA1	0xD4	00000001:OFF
			00000002:MODE1
			00000003:MODE2
			00000004:MODE3
			00000005:MODE4

7.1.8. STATUS OUT

By setting the STATUS OUT menu to ON, the camera status can be output via the serial connection. The camera statuses that can be output via the serial connection are **LIVE, MEMORY, READY, REC,** and **ENDLESS**. The status is output when it changes.

In this manner, the status of the camera can be known without needing to send a request to acquire camera data command.

Below are the serial commands for the camera status.

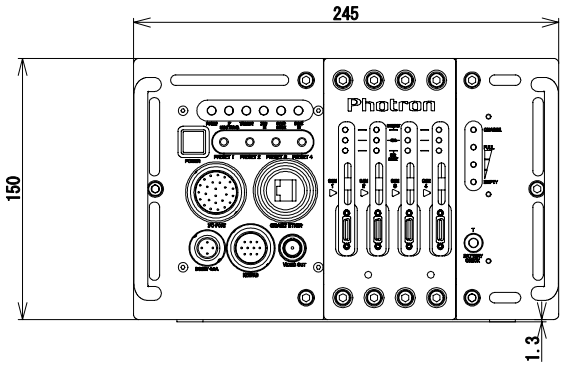
LIVE	0x53, 0x30
MEMORY	0x53, 0x31
READY	0x53, 0x32
REC	0x54, 0x33
ENDLESS	0x53, 0x34

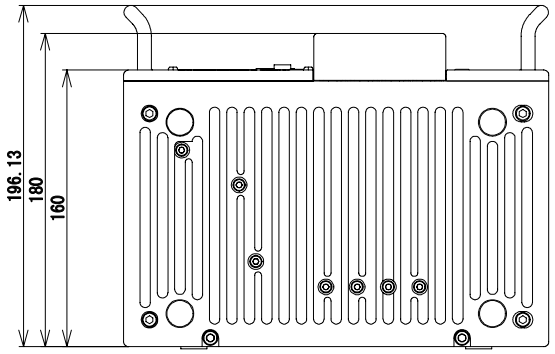
Example: When changing from MEMORY mode to LIVE mode, the camera issues 0x53, followed by 0x30.

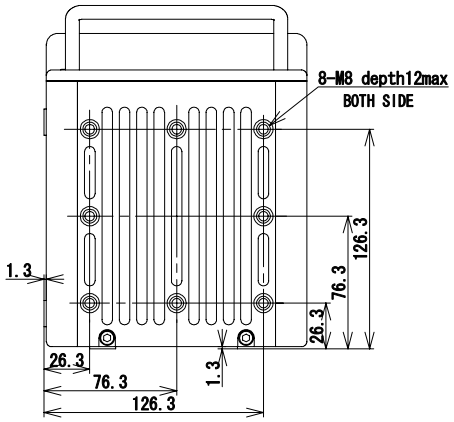
7.2. Dimensions

7.2.1. Camera Controller

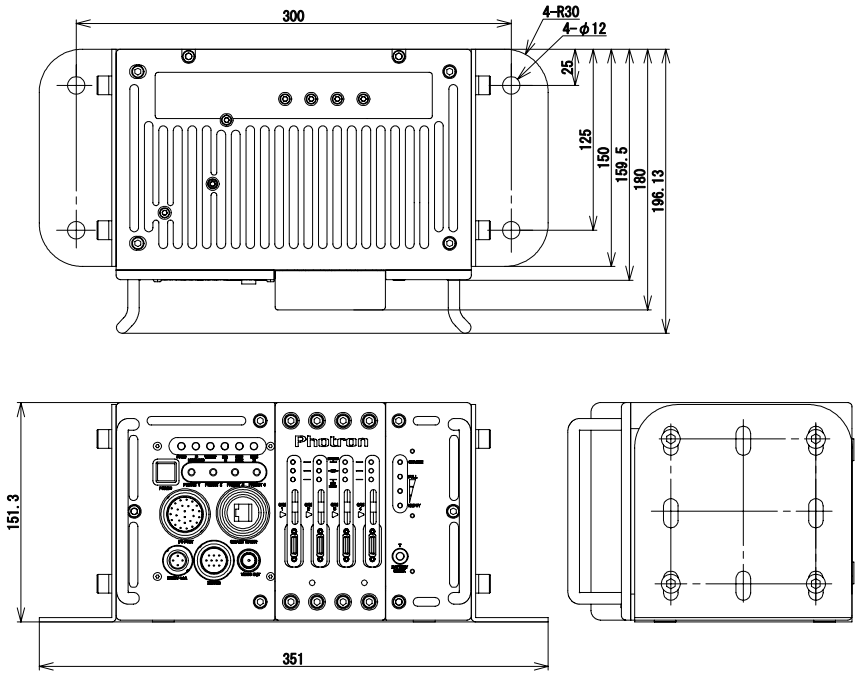
All dimensions are in Millimeters (mm) – 25.4 mm equal one inch.
These diagrams are not shown to scale.



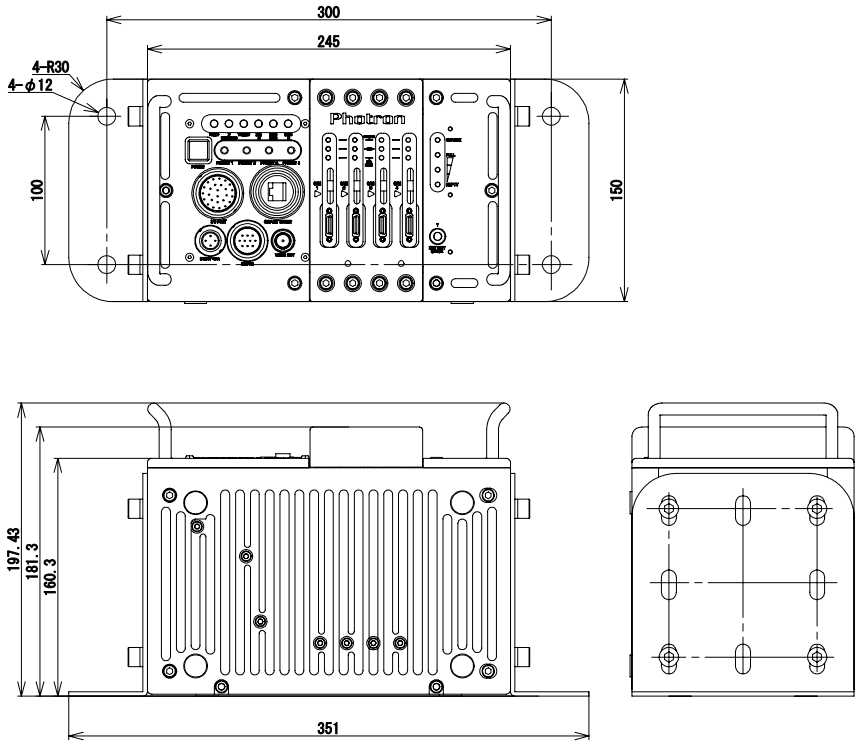




■ Dimensions with Fixing Bracket Attached (Horizontal Mount)

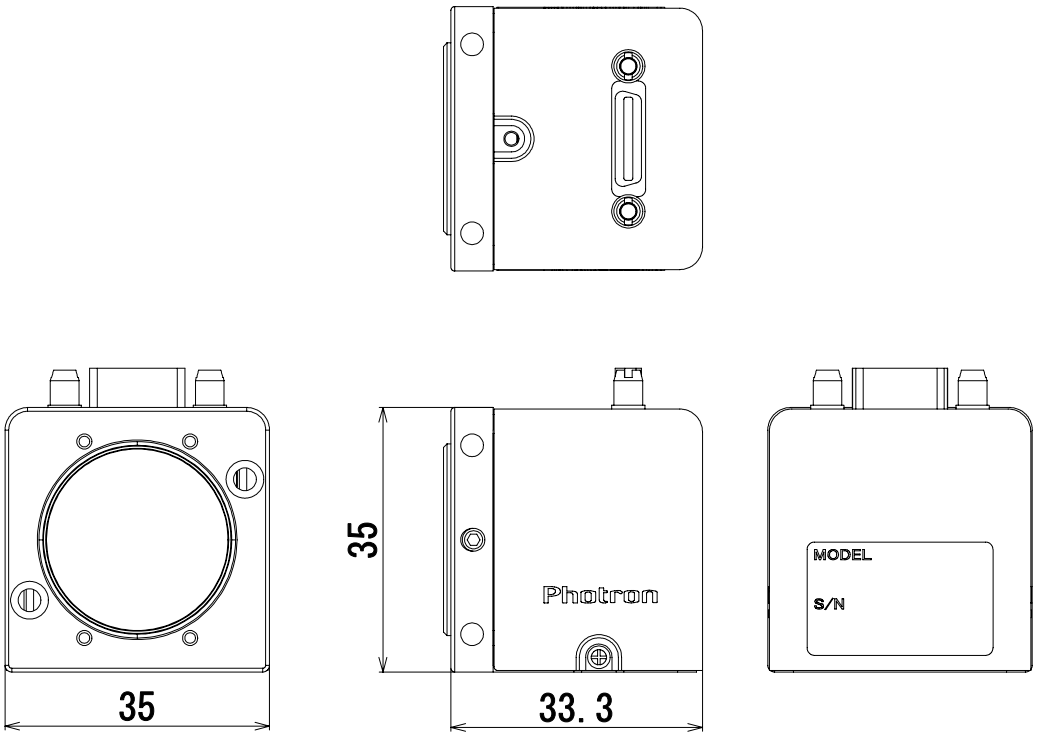


■ Dimensions with Fixing Bracket Attached (Vertical Mount)

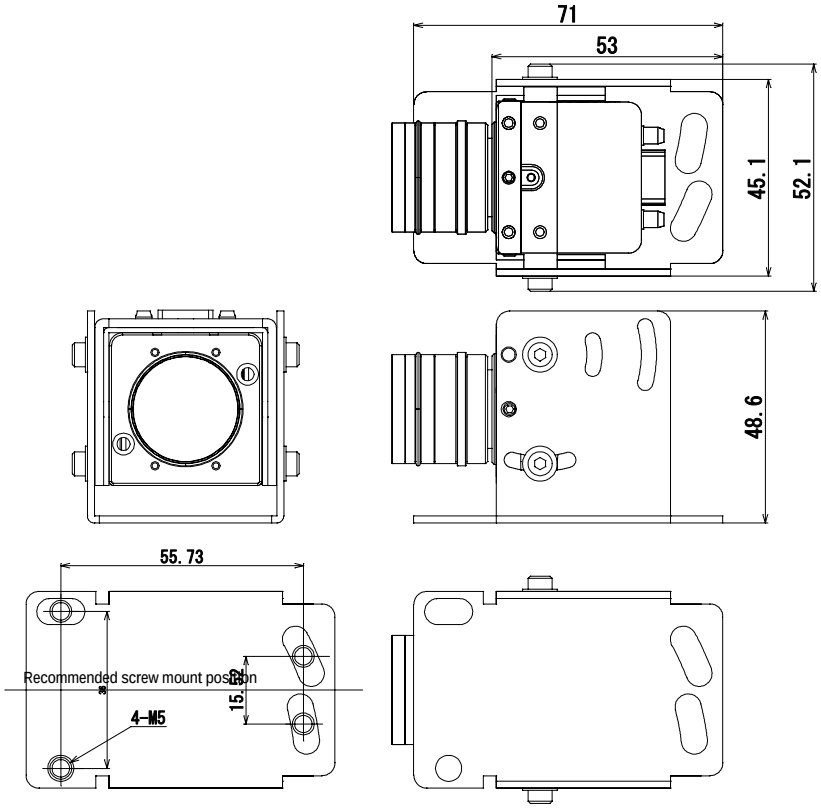


7.2.2. Camera head

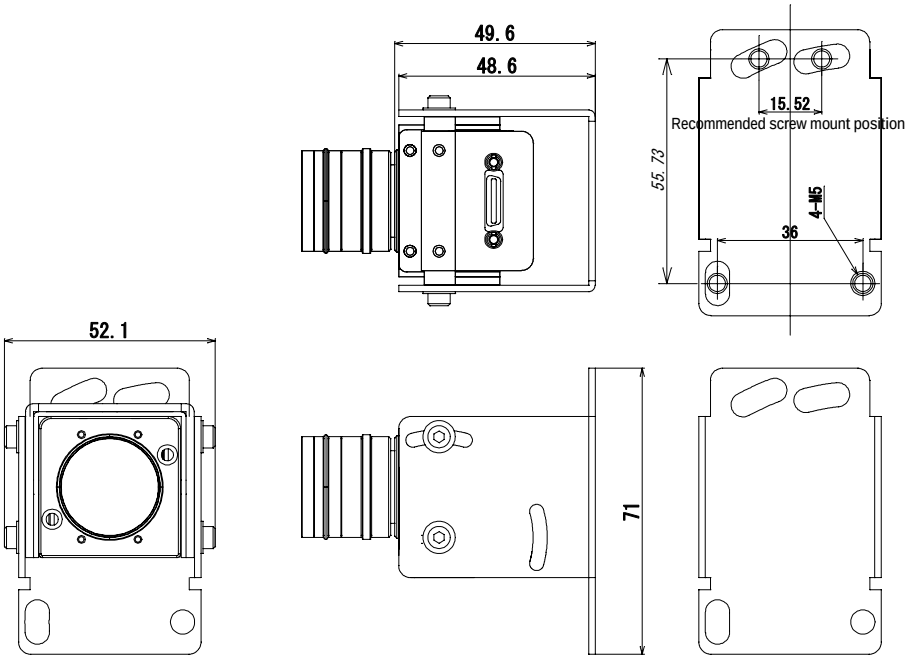
All dimensions are in Millimeters (mm) – 25.4 mm equal one inch.
These diagrams are not shown to scale.



■ Dimensions with Fixing Bracket Attached (Floor Mount)

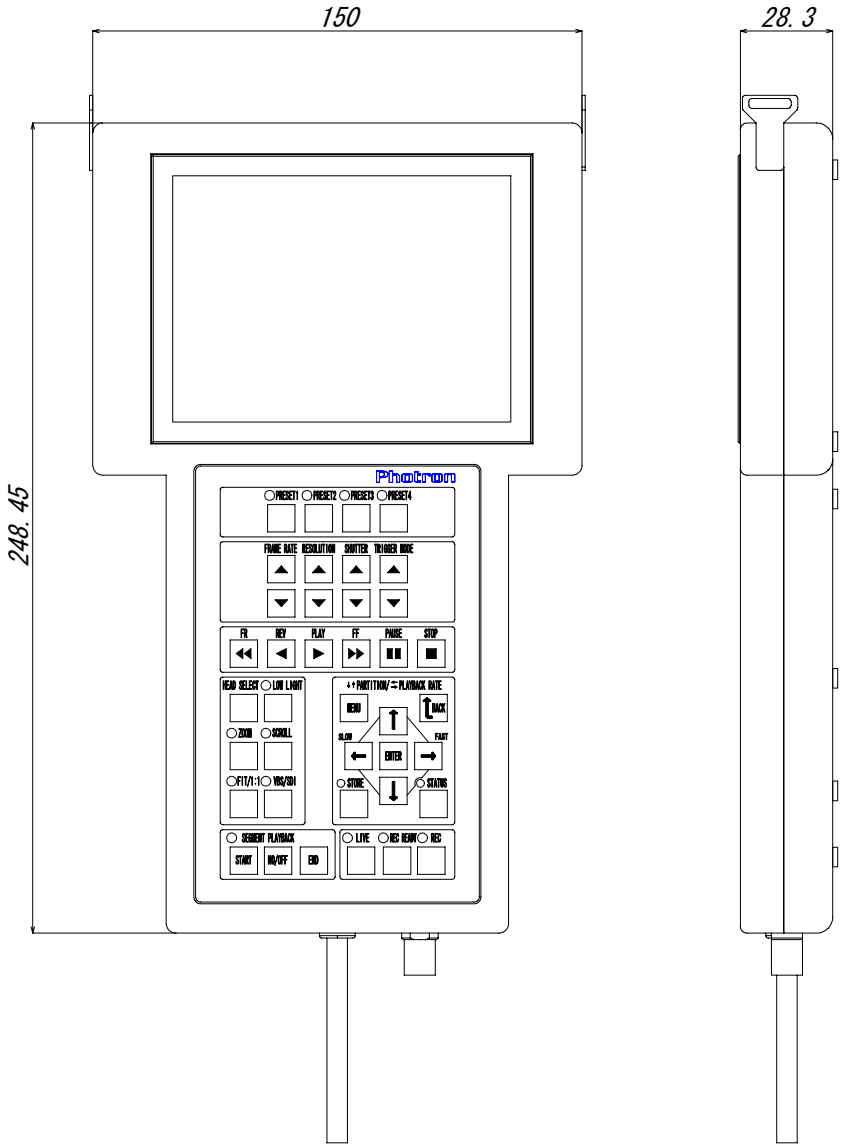


■ Dimensions with Fixing Bracket Attached (Wall Mount)

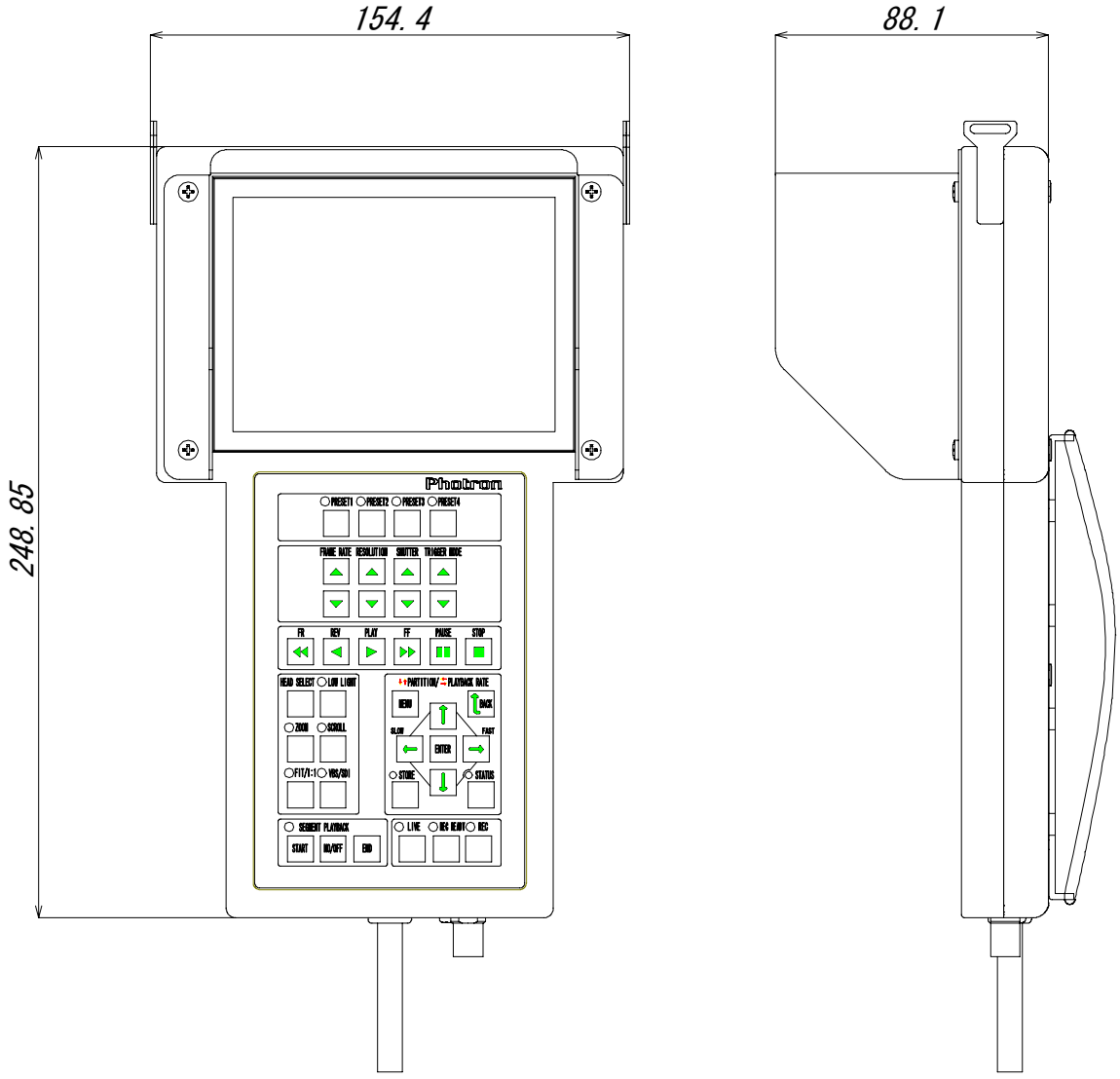


7.2.3. LCD Monitor Keypad

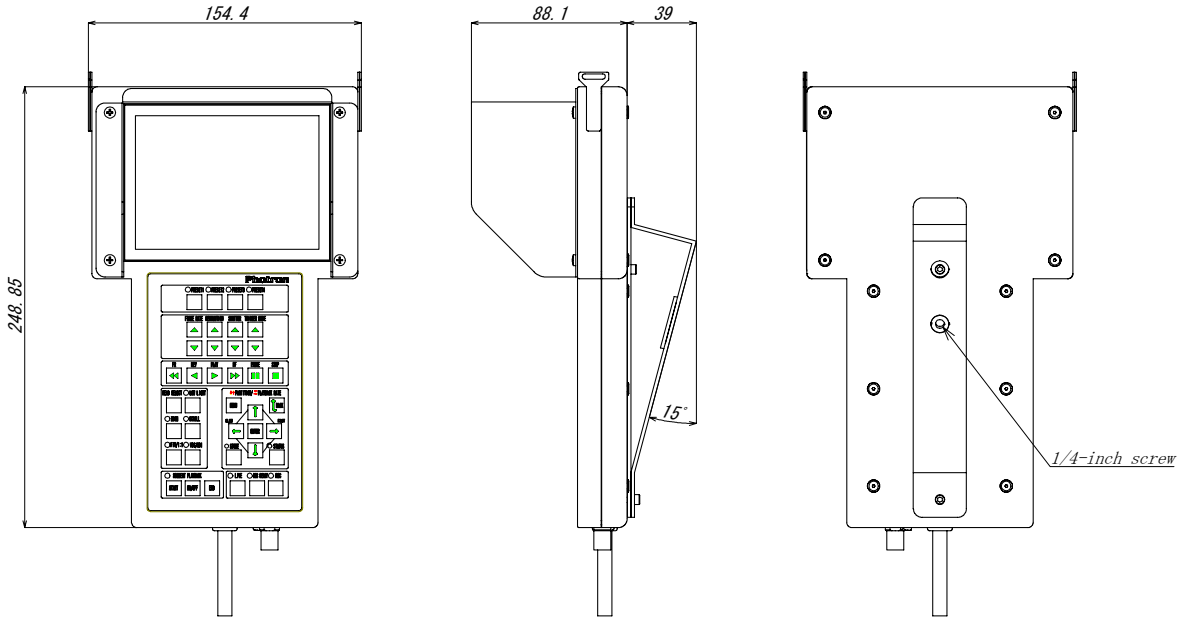
All dimensions are in Millimeters (mm) – 25.4 mm equal one inch.
These diagrams are not shown to scale.



■ **Dimensions with Attached Handle**

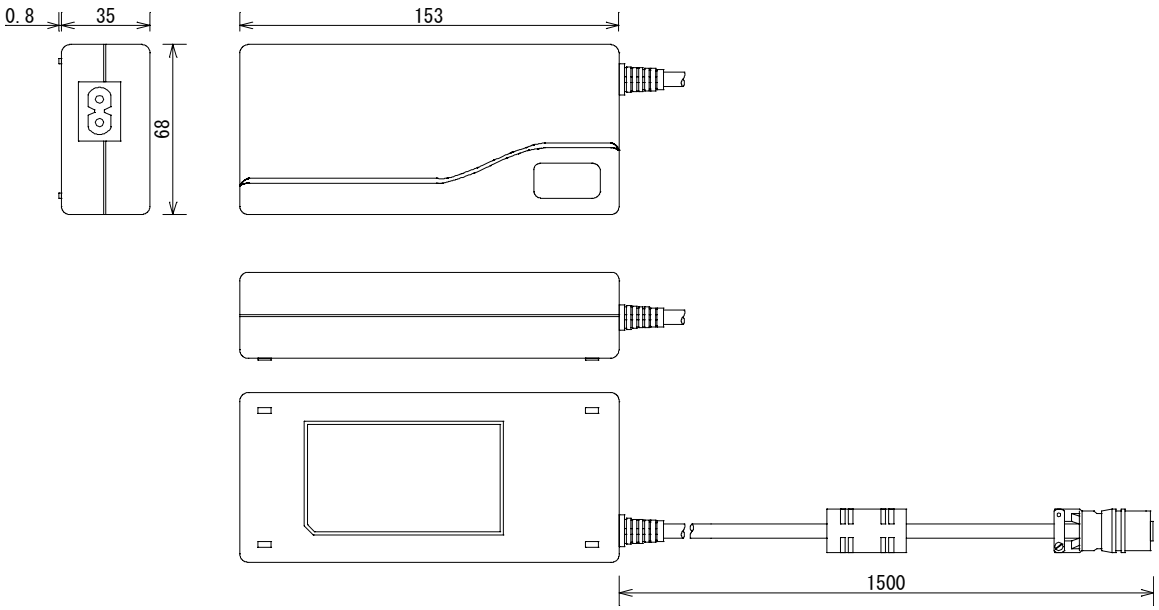


■ **Dimensions with Tripod Adapter**



7.2.4. AC Adapter

All dimensions are in Millimeters (mm) – 25.4 mm equal one inch.
These diagrams are not shown to scale.



Chapter 8. Warranty

8.1. About the Warranty

8.1. About the Warranty

This system has been shipped having undergone rigorous testing. However, in the unlikely event that it malfunctions due to a manufacturing defect, it will be repaired, at no charge, within the warranty period.

When submitting the system for repair, be sure to include the warranty card with the system.

■ Warranty Exceptions

The following exceptions will result in fee-based repair, even within the warranty period.

1. When the warranty card is not presented.
2. The prescribed items on the warranty card are not completed, or they have been overwritten, or the name of the dealer is missing.
3. Damage or malfunction as a result of fire, earthquake, water damage, lightning, other natural disasters, pollution, or the effects of abnormal voltage.
4. Damage or malfunction as a result of dropping or mishandling during shipment or moving after purchase or misuse.
5. Consumable goods (battery, cables)
6. When repair, adjustment, or alternation done by an entity other than Photron service has been performed on the system, or damage or malfunction that is determined to be a result of the responsibility of using the product.

For inquires related to malfunction, contact the dealer where the product was purchased, or the nearest Photron office (refer to page 156).

Chapter 9. Contacting Photron

9.1. Contacting Photron

9.1. Contracting Photron

For technical inquires related to the system, or for inquires related to the user's manual, telephone, FAX, or e-mail using the contact information listed below.

In addition, the following items will be verified when inquiring, so note them in advance.

1. Contact Information: Company name, school name, customer name, phone number
2. Product Name: FASTCAM MH4-10K
3. Serial Number: Check on the nameplate seal.
4. Reason for Inquiry: Condition of the system and what is known about it.

■ Contact Information

In Americas and Antipodes:

PHOTRON USA, INC.
9520 Padgett Street, Suite 110
San Diego, CA 92126-4446, USA
Phone: 858-684-3555
Fax: 858-684-3558
E-mail: image@photron.com
www.photron.com

In Europe, Africa and India:

PHOTRON EUROPE LIMITED
Willowbank House
84 Station Road
Marlow, Bucks SL7 1NK, U.K.
Phone: +44(0) 1628 89 4353
Fax: +44(0) 1628 89 4354
E-mail: image@photron.com
www.photron.com

In other areas:

PHOTRON LIMITED
Fujimi 1-1-8, Chiyoda-Ku
Tokyo 102-0071, Japan
Phone: +81 3 3238 2107
Fax: +81 3 3238 2109
E-mail: image@photron.co.jp
www.photron.co.jp

FASTCAM MH4-10K

Hardware Manual

English Version

Publication Date November, 2006

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Chiyoda Fujimi Bldg., Fujimi 1-1-8, Chiyoda-ku, Tokyo 〒102-0071

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